BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXVII.

1895.

SALEM, MASS.
PRINTED BY THE ESSEX INSTITUTE.
1897.

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OF THE

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VOL. 27. SALEM: JANUARY,—JUNE, 1895. NOS. 1–6.

ANNUAL MEETING, MAY 21, 1895.

THE annual meeting was held in Plummer Hall, this evening, at 7.45 o'clock.

President Edmund B. Willson, in the chair.

The reports of the Secretary, Treasurer and Auditor, Secretary of the Women's Local History class, Librarian, Committee on Publications and Library, were read, accepted and ordered to be placed on file.

The report of the Committee on Nominations was presented by Mr. Geo. H. Allen, and it was

Voted, to proceed to the election of officers by ballot, and the Society voted that the Secretary be authorized to cast one ballot for the whole list of names that had been nominated. This was done and the following persons were declared to be unanimously elected:

PRESIDENT:

EDMUND B. WILLSON.

VICE-PRESIDENTS:

Abner C. Goodell, Jr.
Daniel B. Hagar.
Edward S. Morse.
Robert S. Rantoul.

SECRETARY:

Henry M. Brooks.

TREASURER:

William O. Chapman.

AUDITOR:

Henry M. Batchelder.

LIBRARIAN:

Charles S. Osgood.

COUNCIL:

William H. Gove.
Thomas F. Hunt.
Francis H. Lee.
Richard C. Manning.
S. Endicott Peabody.
George D. Phippen.
David Pingree.
Frederic W. Putnam.
George M. Whipple.
Alden P. White.

Report of the Secretary, May 20, 1895.

It will perhaps be remembered that last year I spoke to you on the great lack of interest, by people in general, in society or corporation reports. This year I have a few words to say on another subject.

Annual meetings, to a large majority of people, are a *bore!* Some may think this is rather a strong expression. I suppose it is, but it is the way such meetings are generally regarded and spoken of. Bank officers have to "scratch round" and get a sufficient number of proxies to elect themselves, and so do the officers of many other corporations. I am telling you nothing new, for this is well known.

But, some will say, how is it with those societies, where they *sometimes* have *full* meetings? My answer to this is, that steps have to be taken to enliven the meeting with something besides the regular business. There must be

speeches, literary exercises or music, or there would be but a slim attendance even at those meetings.

When the time comes round to prepare for *our* annual meeting, I always feel as Artemas Ward said he felt when he was surrounded by the Indians. He wished he had happened to be somewhere else, just at that time; or, like General Butler, when he was out of favor with the Commander-in-chief, ordered to report at Lowell.

Of course, when I come to the meeting, I like to see a good attendance of handsome, well dressed people, of both sexes—like those here to-night—but I have no words of censure for those members who do not care to come, for I might myself, under certain circumstances, stay away.

One very rainy Sunday afternoon, many years ago, the worthy old sexton of the North church was pacing the broad aisle, when the minister, Dr. Brazer, arrived. They were the only persons in the house. The Doctor said—"It doesn't look, Mr. Sexton, as if there would be many here this afternoon." "No, sir," answered the sexton, with his usual rapid and pointed speech, "and you and I, sir, wouldn't be here if we weren't paid for it."

But in spite of what I have had to say on this subject, it is, I suppose, incumbent on the Secretary to sacrifice his own feelings and present for your consideration some statistics, thought to be applicable to the occasion.

The year just closed has been one of comparative prosperity to the society. We have not, it is true, any of those large legacies to mention, which we are always anxiously looking for. But we must continue to work with patience, and have faith that there is a good time coming, some day or other, when we shall have the means to enlarge our building, in order to properly display all our constantly increasing donations.

At the last annual meeting the fact was referred to, that efforts were making to increase our membership, which was then reported as numbering 391. I have now the pleasure of stating that we have more than doubled the number. To be exact, we have at this time 806 members, and eight have become life members.

The life members are Caleb Davis Bradlee, Augustus Hemenway, Robert C. Winthrop, Jr., Edward Wigglesworth, of Boston, James J. Higginson, of New York, Horace Fletcher, of New Orleans, Geo. Peabody Wetmore, of Newport, R. I., C. W. Galloupe, of Swampscott.

This is certainly a good showing and proves that the method adopted by the Secretary is a good one, whatever any chronic fault-finders may have to say to the contrary,—I mean if we have any such characters about. I hope we haven't.

We must continue this work until we have obtained at least 1,000 members, then we can take a short vacation.

The question has been asked how many members we have outside of Salem. About 300, in 65 different cities and towns throughout the country, and one member in Birmingham, England.

The following members have died during the year: Lincoln F. Brigham, Caleb Foote, John W. Masury, of New York, Daniel Needham, of Groton, Fitz W. Perkins, George W. Pousland, of Boston, Thomas E. Proctor, of Boston, Henry Saltonstall, of Boston, A. A. Scott, of Saugus, Leverett Saltonstall, of Newton, Joseph W. Lefavour, of Beverly, Matthew A. Stickney, Dr. George A. Perkins; and of Honorary Members, Robert C. Winthrop, of Boston, Prof. James D. Dana, of New Haven, Oliver Wendell Holmes, of Boston, E. Rockwood Hoar, of Concord.

The free course of lectures the past season in Plummer

Hall was apparently quite satisfactory to the audiences, which were generally much larger than in previous years. The lectures have been by Prof. T. C. Mendenhall, of Worcester, Richard Hodgdon of Boston, Dr. George A. Dorsey, of Cambridge, Howard Walker, of Boston, Gamaliel Bradford, of Boston, George S. Hale, of Boston, Charles Carleton Coffin, of Boston, Rev. Dr. Pullman, of Lynn, Miss Lucia T. Ames, of Boston.

There have been twenty-three regular meetings of the Society held this year; a larger number, I think, than has ever been held in any year previous. The evening meetings in the Library room have been well attended. Papers have been read by the following persons: Herbert E. Valentine, of Somerville, John Robinson, Prof. E. S. Morse, John H. Sears, Hon. R. S. Rantoul, Frank Cousins, Mrs. H. W. Edwards, Mrs. E. A. Kilham, of Beverly, Miss Helen D. Lander for Miss Lucy Perry, Mrs. R. C. Manning, Miss Mary S. Cleveland, Miss Abby L. Read, Miss Irene Weir, of Boston, and three papers by the Secretary.

These papers were discussed by various members of the Society. There is a great interest taken in these meetings, which is very encouraging to those who planned them. The only drawback seems to be that some of our members, who would gladly take part, have engagements elsewhere on Monday evenings. But it might be the same if we had the meetings upon any other evening.

Our regular meetings, in accordance with the by-laws, occur on the first and third Monday in every month. They have been held this season in the evening, from the first Monday in December until the first Monday in May. During the summer months they are usually held on Monday mornings, for business only, and notice is given in the newspapers of the city on Friday and Saturday previous. I mention this here because members sometimes say they

do not know when we have our meetings, or they would be present.

At the last annual meeting it was stated that some of the women connected with the Society proposed to form a class for the study of local history. Such a class was begun early in June last, and has continued during the year. Miss Helen D. Lander, the Secretary, will read to the meeting a most excellent report of the doings of that very successful class. With regard to this matter, I have only to say that, in my judgment, this is the most important movement made in the Institute for years. I will not except even the Chicago boom,—for one of the principal objects of the society is the investigation and study of local history.

As is perhaps well known almost everywhere now, we hold the key to the broadest church in the land. Roman Catholics, Protestants, Trinitarians and Unitarians, all go to this church. Between 9,000 and 10,000 have been into the church this year, the largest number ever reported. It is amusing to hear remarks often made about this house of worship. As we have a card posted up explaining the matter, visitors have ceased to ask how they got up in the gallery. One party who applied for admission asked if they "could be permitted to walk through the church," meaning, I suppose, up the broad aisle and down another. One man from New York, upon returning the key, said, "That'll do well enough to show to countrymen, but I can hardly swallow it." One person asked how long the church continued to be Baptist after Roger Williams left. Another asked if all the seats were like the old "settle" we have there.

The following societies have visited Salem the last year and received attentions from the Institute and the Peabody Academy of Science: The Auburndale Review Club, on June 5, the Asbury Grove Methodist Trustees on June

15, and on August 2, sixty members of the American Society of University Extension under the direction of Prof. Lyman T. Powell, of Philadelphia. This society, under the escort of a committee of the Institute, was taken about the city to historical points in barges, lunched in Plummer Hall at 12 o'clock and attended a meeting at Academy Hall in the afternoon, where Hon. R. S. Rantoul gave a fine address on the history of Salem during the Revolution. The visitors expressed themselves as greatly pleased with the attention they received, and with what they saw and heard on this occasion. Professor Morse and the Secretary by invitation, represented the Institute at a reception given to the "Historical Pilgrims" in Boston, on the succeeding Friday evening.

As usual, several schools and classes have visited our rooms the past year. These excursions are becoming so general with the increase of the "travel habit," which has taken possession of most people, that any record of them, ceases to be of special interest to any of us, I imagine. I will mention, however, that on the 31st of last May, the architectural class of the Massachusetts Institute of Technology made a visit to Salem for the purpose of studying examples of colonial architecture. This class was taken to points of historical note about town by a committee of the Institute, and two or three evenings our rooms were opened to them that they might study any objects of interest to be found there. The first evening the class was introduced by Mr. Ross Turner to the officers and committees of the society, who gave an informal reception from 8 to 10 o'clock, with a light lunch, music, etc.

The large and valuable collection of manuscript letters and papers left to the society by Dr. Wheatland have been carefully examined and arranged by Wm. P. Upham, Esq., curator of manuscripts, and these are now in the

hands of our library assistants who are placing them in scrap books for their better preservation.

The donations to the Cabinets the past year have been 470, from 132 donors. Among these donations were an ancient sword, silver case and hilt (marked 1319) from Miss Mary Ellen Briggs; a wooden bust of Hippocrates which, in Oct., 1771, was a sign for Nathaniel Dabney of Salem, apothecary; a cradle used by Judge Story and afterwards by his son Wm. W. Story; and several very finely carved tortoise shell combs from the Misses Cleveland.

From the late Judge E. Rockwood Hoar, a gold watch, key, seal and chain, which belonged to Major John Clarke, who was at the capture of Quebec in 1759; and an early Chickering piano from Mrs. W. A. Lander; from the Salem Marine Society, miniatures on ivory, of Capt. Jona. Lambert and Capt. Samuel Lambert, of Salem, and from Prof. Alpheus Hyatt of Cambridge, a slave whip.

We have also been presented with a Bull.* He is, however, somewhat aged and infirm and will have to be doctored before he is ready for a bull fight, or can be exhibited. Besides this we have some of the bones of George Jacobs, who was executed for witchcraft.

An album of leaves and flowers gathered in Italy by Una Hawthorne in 1858–9, sent to us by Richard Garnett, Esq., of the British Museum, London.

These are a few of the most noted donations, for we could not enumerate all in this report.

The Society still wants room, money and members—the young and old of both sexes.

Which is respectfully submitted,

HENRY M. BROOKS,

Secretary.

* Made of wood, used as a sign by Jona. Andrew in 1769, near Williams Street.

Report of the Librarian.

The additions to the library for the year (May, 1894, to May, 1895), have been as follows:

By Donation.

Folios,	23
Quartos,	75
Octavos,	517
Twelvemos,	177
Sixteenmos,	119
Twenty-fourmos,	39
Total of bound volumes,	950
Pamphlets and serials,	3,563
Total of donations,	4,513

By Exchange.

Folios,	5
Quartos,	21
Octavos,	184
Twelvemos,	1
Total of bound volumes,	211
Pamphlets and serials,	1,819
Total of exchanges,	2,030

By Purchase.

Folios,	4
Quartos,	3
Octavos,	12
Twelvemos,	25
Total of bound volumes,	44
Pamphlets and serials,	441
Total of purchases,	485
Total of donations,	4,513
Total of exchanges,	2,030
Total of purchases,	485
Total of additions,	7,028

Of the total number of pamphlets and serials, 2,244 were pamphlets and 3,579 were serials.

The donations to the library for the year have been received from two hundred and one individuals and ninety-three societies and governmental departments. The exchanges, from ten individuals and two hundred and nineteen societies and incorporated institutions, of which one hundred and twenty-two are foreign; also from editors and publishers.

To these facts and figures the librarian has but little to add. The ordinary routine work of the library has been performed quietly and effectively and, we have reason to believe, has been appreciated by many students and investigators. There have been no large donations as in many former years which accounts for the much smaller increase of the library, although the number of donors and exchanges have not materially changed.

The use of the library shows a steady increase from year to year, one reason for it this year being found in the impetus given to local historical research by the formation, by the ladies connected with the Institute, of the history class to which reference is made in the other reports.

During the year the magazines in the library, both bound and unbound, have been arranged, and an alphabetical list of them made, so that it is now possible to tell at once what numbers of the different magazines we have and what are our deficiencies. This will be found a great convenience to all who wish to consult them.

The long-looked-for, and confidently expected addition to the funds of the Institute, has not as yet been forthcoming, but we do not lose heart on this account. During the past year we have made an almost phenomenal addition to our list of members. This brings to the mind of

many more persons the wants and needs of the Institute and the good work it is doing for the county and city. From this largely increased membership, or by means of it, we hope and believe that some will be interested to the extent of furnishing, in some form, a substantial addition to our available funds. When we realize how much has been done by the Institute, at a comparatively small expense, we can form some estimate of how much the public would be benefited were a larger fund placed at its disposal.

The needs of the library are a stack room for books and a catalogue. Our ever increasing number of books, now about 65,000 bound volumes and 200,000 pamphlets, make the first a pressing necessity which we have partly relieved by the undesirable method of storing those least used outside the library building, and the second is needed that the users of the library may be able to know just what it contains on the subjects upon which they desire to inform themselves. Both these needs appeal to the liberality of the public and must await the time when that liberality shall manifest itself.

In conclusion, the librarian would congratulate the members on the possession of a library somewhat unique in character, and one which, notwithstanding all the drawbacks, is frequently and profitably consulted.

CHARLES S. OSGOOD,

Librarian.

Treasurer's Report.

RECEIPTS.

Balance from last report,		$508 97
Received from invested funds,	$2,777 05	
" " assessments of members,	1,986 00	
" " life membership fees,	400 00	
" " publications,	528 14	
" " other sources,	90 47	
		5,781 66
Money borrowed,		1,500 00
Interest received and funded,		12 58
		$7,803 21

Also received from Almy, Bigelow & Washburn, $25, the nucleus of a Reception Fund.

EXPENDITURES.

Salaries of secretary, assistant librarians and janitor,	$2,458 00	
Fuel,	309 75	
Lighting and water,	102 72	
Labor, etc., on grounds,	51 15	
Postage and express,	173 44	
Supplies,	72 90	
Insurance,	45 00	
Interest on loan,	208 50	
Furniture and fixtures,	158 87	
Storage,	51 80	
Lecture expenses,	62 42	
Reception "	197 35	
Our proportion of Athenæum expenses,	246 54	
Repairs,	158 68	
Books,	422 72	
Publications and printing,	1,626 62	
Miscellaneous,	29 42	
Annuities,	610 00	
		$6,985 88
Interest added to manuscript fund,	7 30	
North Bridge monument fund,	5 28	
		12 58
Balance of cash on hand,		804 75
		$7,803 21

Respectfully submitted,

W. O. Chapman, *Treasurer.*

Auditor's Report.

Salem, May 20, 1895.

The treasurer's accounts and books have been examined from the last annual meeting to date.

The receipts appear to be correctly entered and the expenditures properly entered and vouched.

The securities herein reported by the treasurer were examined on May 18, 1895, and agree with the list submitted within.

Respectfully submitted,

H. M. Batchelder,

Auditor.

Library and Publication Committee Report.

The Library and Publication Committee respectfully presents its report for the year ending May 20, 1895.

The condition of the library has undergone no considerable change and is clearly indicated in the exhaustive report of the Librarian. The library increases with a steady and healthy growth, and so in an unmistakable degree does the use of it, and the need of much additional shelf-room is once more pressing upon us.

The publications of the Institute have now been sustained in a manner which is recognized as creditable, for a series of years dating from 1856–7, when the Institute moved into Plummer Hall, and when six volumes of Proceedings, covering the work of the society from its inception in 1848, were begun and published at intervals through a dozen years. In 1869 the Proceedings made way for the Bulletin, now in its twenty-sixth volume, which has, for a reason about to be disclosed, become

scientific in the main, although still embracing the current record of the doings, the meetings and the necrology of the society.

In April, 1859, a new publication, devoted to historical matter, was begun, which has now reached a total of thirty completed volumes. It has been sustained without a break. The spirit in which it was conceived and carried on appears from the introductory notes which preface each of the first eight volumes.

At first such material as came to hand and seemed worthy of perpetuation in type—historical sketches, copies of records, and essays in antiquarian research—was printed, by a mutually convenient plan, in the columns of the Salem Gazette, and before distribution of the type, a limited number of extra copies were run off, paged up in a form to be bound into a periodical volume, and hence the double columns and peculiar shape of the page in the first eight volumes of our Historical Collections. But in 1869, not without a good many pangs amongst the more conservative of us, it was decided that these swaddling clothes had been outgrown, and our publications took on the decorous and customary form of the regulation octavo page.

During this series of forty years the Institute has printed and put on record very little matter which has not sufficient interest and value to warrant its preservation. Some of the articles in this long series have possessed an exceptional importance and a literary quality which has been recognized by the public. Some have been the work of persons of established literary, scientific and genealogical repute. On the whole it is not presumptuous, perhaps, to claim that our publications, as compared with others of their class, contain a fair share of matter which would be accepted as of value in the current issues of the press.

Yet, notwithstanding the unstinted efforts which have been made to keep up the standard of our publications and to bring their merits to the notice of appreciative readers —notwithstanding the frequent expressions of pride and satisfaction in the work which prevail about us,—the fact remains that no appeal to the people of Essex County, be they members or non-members of the Essex Institute, to sustain these publications has any effect; that no considerable portion of the cost of production can be met by sales, and that their remunerative value to the Institute lies in their availability in exchange.

As books of reference in the libraries of the country, they are used by persons pursuing genealogy, local history and natural science. We have had occasion within a year to refer an English investigator to a copy of our Historical Collections which is on the shelves of the British Museum. As a purchasing medium, they bring us large accessions of books from outside sources in the way of exchange. As a ready source of information which could not be reached without them, except through protracted research, they are drawn on by newsmen and genealogists and antiquarians and historical students, as unconsciously as the air they breathe, and, for the most part, with as little sense of dependency or obligation as the bird feels towards the atmosphere in which it floats. Perhaps this is as it should be; clearly it is beyond our power to change the fact, and we have either to support the publications on these terms or suspend them altogether.

Besides parts four, five and six of volume twenty-six —the current volume—of the Bulletin, comprising valuable contributions from Mr. Sears and the annual reports, and besides the second half of volume thirty of the Historical Collections, wholly given up to the memorial tribute to Doctor Wheatland, and the first half of volume

thirty-one containing church records, family history, etc., there have been printed and issued the following extras:

1. A Partial Catalogue of Publications on sale.

2. The Annual Report for 1894.

3. Baptismal Records of the Church in Topsfield, copied by Geo. Frs. Dow.

4. A Geological Report by Mr. Sears to accompany his map.

5. Geological and Mineralogical Notes, parts 7 and 8, by Mr. Sears.

6. The Wheatland Memorial in pamphlet form.

7. Salem and the Conkling Family, by Frank J. Conkling, Brooklyn, N. Y.

8. The Pepperrell Portraits, by Cecil Hampden Cutts Howard, Beebe, Ark.

In commemorating the founder of the Institute, as the occasion was unique, so a course was followed not altogether usual and, it was apprehended, open possibly to adverse remark. Instead of presenting a carefully drawn sketch, the work of a single hand, which must exhibit at once the capabilities and the limitations of the limner, it was thought the better plan to collate, in one volume, estimates and characterizations of the distinguished subject from a multitude of appreciative sources, thus perpetuating, so to say, a rounded statue observable from many points of view, rather than a canvas offering only one. So far as your committee have been informed, the departure has not been considered an unwise one.

The elaborate map exhibiting the surface geology of the county, prepared by the curator of that branch in the Peabody Academy of Science and promised us for publication last year, has been issued by the Institute and has been received with favor.

A trustworthy Guide to Salem and the adjoining region

has been for years a desideratum with visitors at the Essex Institute, and several books of no mean pretensions have been furnished of late by private enterprise. One of these has already reached its thirty-second thousand and has enjoyed the commendation of critical journals in remote sections of the country. It has seemed advisable, this year, for the Institute to assume the publication of such a guide. For this purpose the valuable accumulation of material in the "Visitor's Guide" has been placed at the service of the Institute and, largely extended and revised with care under the supervision of the committee, it will be issued at once and will bear the imprint of the Essex Institute. It is thought to be as free from inaccuracies as is fairly to be expected. Such errors as may linger in it, will, as they are discovered and pointed out, disappear in subsequent editions.

The committee are unable to close this retrospect of the year without alluding to a new element of Institute work which has come to their notice, and which seems to them to be of rich promise for the future. The class of ladies who have taken up, as a recreation, the pursuit of local history and antiquities, embodying the results of their research in a series of short, carefully written and well-constructed papers, have been pleased to place these at the service of the Essex Institute for reference or publication. While some of the best of them, from the necessity of the case, are made up largely of material already to be found in our pages and are therefore of no value to us, as contributions to our collections, commensurate with their literary quality, there are others, and these not a few, containing original features of marked merit,—some new mode of treatment of a familiar topic,—some new light thrown on a conspicuous character,—some new view of an event heretofore regarded from an ill-selected standpoint,

—which make the papers distinct contributions to the store of knowledge this committee is endeavoring to accumulate. It can hardly be that this new movement will fail of rendering welcome aid in our historical labors.

ROBERT S. RANTOUL.
GEO. M. WHIPPLE.
CHAS. S. OSGOOD.
EDW. S. MORSE.
WILLIAM H. GOVE.
ALDEN P. WHITE.
SIDNEY PERLEY.

LOCAL HISTORY CLASS REPORT.

It has been suggested that it might be of interest to the members of the Institute to hear a short report of the work of the Local History Class, a branch of the parent tree, to a report of whose proceedings for the past year, we have just had the pleasure of listening.

At the last annual meeting of the Institute a suggestion was made that a class should be formed for the study of our local history. It was thought this study might prove interesting and instructive.

In pursuance of this suggestion, Mrs. Henry M. Brooks, with a view to finding out if such a class would be desirable, talked over the matter with a few persons, and, as a result, a meeting to consider the question was called for Thursday afternoon, May 24th, at the Institute rooms. The day proved very stormy and but three persons were present: Mrs. Brooks, Miss Arvedson and Miss H. D. Lander. Of course no formal action towards the formation of a class could be taken, and the meeting adjourned to June 6th.

At that meeting nineteen persons were present. It

was voted to form a class for the study of our local history, to hold weekly meetings on Tuesday afternoons; the hour of meeting to be four o'clock; the time of the session to be limited to one hour; the place of meeting, the Henry Wheatland library room, the use of which was offered to the class.

Mrs. Henry M. Brooks was chosen chairman, Miss H. D. Lander, Secretary, and Miss M. E. Arvedson, Reference Librarian.

At first the members read extracts from books containing accounts of life in the early times. In a few weeks they began to write papers, gathering the facts from the books, but telling the stories in their own words. The interest has increased greatly as the study has progressed. Forty-nine papers have been prepared upon a variety of subjects, including the lives of the early planters, of the early governors, of the first ministers, and of the notable women of those early days, who so bravely endured the hardships and privations, and often the persecutions to which they were exposed. Papers have been written also descriptive of the places prominent in our early history: North and South Fields, Salem Neck, and Salem Common.

Accounts have been given of Salem's early commerce, ship building, the early New England fisheries, schools and school-masters, the establishment of Harvard College, custom houses, taverns, slavery, travelling, the early Quakers, and the cruelties and persecutions they suffered at the hands of the Puritans. A paper dealing with Roger Williams' life in Salem, and the persecutions inflicted upon him by the magistrates, drew forth a paper from another member of the class, taking the other side, and, as the title sets forth, "Trying to prove that the magistrates had some reason in their sentence of banishment of Roger Williams from the Massachusetts Colony, from their point of view."

A paper describing the persecutions the Episcopalians underwent from the Puritans was followed by another paper called "A Defence of the Puritans." A discussion usually follows the reading of the papers and often new light is thrown upon a subject in that way.

Chronologically speaking, the class has not made much progress, as the field of interesting material concerning the very early days has not yet been exhausted. The last paper was upon John Woodbury.

Several gentlemen, members of the Institute, have very kindly consented to address the class from time to time, at Plummer Hall, and there have been given many not only delightful, but also very instructive afternoon talks on subjects bearing upon the work the class has been doing. Mr. Rantoul gave the first informal talk on "Life Among the Early Planters," which was most interesting. He was followed by Rev. E. B. Willson, with a charming sketch of "Life Among the Early Ministers." Next Mr. Sidney Perley gave a very instructive and interesting talk upon the "Interpretation of old Colonial Manuscripts," illustrated by blackboard drawings. Mr. Ezra D. Hines took the class one afternoon, in imagination, upon his picturesque and attractive ramble over "An Historic Highway." Jan. 1, Mr. Henry M. Brooks read a most delightful paper, entitled "Old Schools." At the close of this paper, in celebration of the day, a bowl of "Literary Salad," containing quotations from the papers which the members of the class had written, was passed around. Each person took a lettuce leaf with quotation attached and was requested to bring to the next meeting the name of the author.

Soon after this meeting, Hon. Alden P. White gave, with blackboard illustrations, his most charming and fascinating "Evolution of Essex County."

One afternoon Mr. Frank Cousins took the class upon

an imaginary walk through the streets of Salem, describing very graphically, the various points of interest.

Mr. Brooks very kindly repeated, lately, his recent paper upon "Early Localities," followed by some extracts from the paper called "Some Eccentric People." Both of these papers were very enjoyable.

Last September, the Danvers Historical Society, through Mr. Hines, sent a most cordial invitation to the class, to attend a field-meeting at Danvers Centre. Twenty-five persons availed themselves of this opportunity to visit the places of historic interest in that town, under such admirable guidance. After studying the Ingersoll Boulder, lately placed upon the Common and visiting other interesting spots, the party adjourned to the Chapel of the First Church, where Mr. William P. Upham gave a most carefully prepared paper upon the ancient land grants in that vicinity.

The class numbers at present sixty-four members, and new ones are constantly being added. The largest number of persons at any meeting has been forty-eight, the smallest twelve, with an average attendance of twenty-eight.

Through the winter the hour for beginning the meeting was changed to half-past three as the Institute Rooms closed at five o'clock. Since May 1, the original hour of four o'clock has been resumed.

The question has often been asked to whom is this Local History Class open, and how is membership obtained? The class is open to any member of the Institute or to any person a member of whose family belongs to the Institute.

No formality is required to become a member. Any person fulfilling the above condition, who feels interested

in the subjects the class is studying, will be most cordially welcomed any and every Tuesday afternoon.

Respectfully submitted,

H. D. Lander,

Secretary L. H. C.

Lectures and Meetings.

Regular Meeting, Monday, June 18, 1894.—The Secretary stated that he had just heard of the death of Hon. Caleb Foote, who had been a member of the society from its organization in 1848, and one of its best friends. Upon motion of Capt. George M. Whipple, it was voted, That the Secretary be instructed to write a letter of condolence to the family of our revered friend, expressing the feelings of the members of the society upon the loss sustained by them in this event.

In accordance with the above vote the Secretary wrote to Mrs. J. B. Tileston at Mattapan (daughter of Mr. Foote) : " It is the sense of the members of our society that in the removal, by death, of our late associate, the Hon. Caleb Foote, we have lost a most valued member and kind friend, who was always ready to aid us in our work in every way in his power, by liberal contributions of books for our library, as well as by his ready pen whenever occasion required. His memory will long be cherished by us, as having been one of the most genial and worthy persons connected with the society. In communicating this vote I would most tenderly offer to the family my heartfelt sympathy with them in their bereavement."

Tuesday, July 10, 1894.—A field meeting was held this day in Lynn Woods. About fifty members took a special electric car at 9.15 o'clock and reached the woods

in about an hour; some members went in a later car. During the forenoon a portion of the party visited the "wolf pits" and other places of interest, under the guidance of Nathan M. Hawkes, Esq. Lunch was eaten at 1 o'clock near the summit of Mount Gilead. At 2 o'clock the meeting was opened by President Willson with some interesting remarks explaining the objects of field-meetings, that for many years had been pursued by this society:— the study of history, botany, geology, etc., by visits to fields and woods, more especially in the county of Essex. The speaker wished it understood that this was a county society and not merely a Salem institution. Mr. Willson referred to the beautiful park in which we were holding our meeting and wished Salem could boast of something of the sort. Mr. Hawkes gave a full account of the establishing of the park and told how the property was acquired. Professor Morse spoke in his usual entertaining manner of the value and importance of out-door education. Alderman Gove hoped Salem would do something to get possession of the territory between Lynn and Salem for a park—that part between the railroad and the turnpike. In the same line were the remarks of W. S. Nevins, Dr. H. C. Merriam, Dr. Jesse Robbins, Captain Whipple and C. H. Preston of Danvers. A vote of thanks was given to Mr. Hawkes and others for courtesies extended. Meeting adjourned at 4 P. M.

Thursday, August 2, 1894.—About sixty members of the American Society of University Teaching, under the direction of Prof. Lyman T. Powell, visited Salem this day and were entertained by the Institute and Peabody Academy of Science. They arrived in town at 9.30, and were met at the railway station by a committe of the Institute, with barges, and taken to our rooms, where they examined our collections; they then took the barges again and were

driven about the city to points of historical interest. Returning at 12.30 o'clock, a lunch was served in Plummer Hall where about one hundred persons, including the Committee, sat down to a lunch by Caterer Wentworth. At two o'clock a meeting was held in Academy Hall at which President Willson, in a few well chosen remarks, introduced Prof. E. S. Morse who gave a brief history of the Institute and Peabody Academy. The Hon. R. S. Rantoul then delivered a scholarly address, abounding with information, on the history of Salem in the Revolution. He was followed by Professor Powell who made a pleasant speech expressive of the appreciation and thanks of the visitors for the reception and courtesies extended to them. The guests then visited the Museum of the Peabody Academy and afterwards took the cars for Boston or Marblehead.

Regular Meeting, Monday, Aug. 20, 1894.—The Secretary called the attention of the members to the death of Mr. M. A. Stickney which occurred on the 11th inst. The following resolutions offered by Mr. Rantoul, seconded by Mr. Cousins, were adopted. *Resolved:* That it is with a deep sense of loss and regret that the Essex Institute is called to record the death of Matthew Adams Stickney, at the ripe old age of eighty-nine. His early, constant, and unfaltering devotion to the interests of this society, dating from a time when its existence from year to year was only secured by the untiring zeal of a few promoters like himself, deserves to be remembered now when the records of the society's stability and usefulness cover half a century. Born of an ancient Essex County stock, leading a life pure and lofty in its aims and exemplary in all its relations, his estimable qualities widely recognized as they could not fail to be, and honored with membership in many leading archæological and literary societies of the

country, a naturalist at the age of ten, devoted to the study and to the collection of specimens which came to possess a rare interest and value, a careful student of genealogy and family history, leaving much of his research in print, besides a fund of manuscript material most helpful to those who follow him,—he made his acquaintance an invaluable privilege to the student by a wealth of personal reminiscence; by an acquaintance with the dark history of Gallows Hill, under whose shadow he passed his life, and of the Witchcraft period of which he made a specialty; while his gathered store of antique furnishings, publications and coinage made his comfortable homestead a Mecca for the bibliophile and the archæologist. His accumulation of coins and medals of British and American issue, of colonial and provincial currency, of continental paper money, of New England almanacs, covering more than two centuries in their publication, of autograph letters, French, English and American, illustrating our Revolutionary period, represented the devotion of a lifetime and challenged comparison with the most exhaustive collections in the country. With the exception of six consecutive years during which Mr. Stickney was the librarian of the Essex Institute, he was curator of numismatics from the foundation of the society in 1848 until his death."

The Secretary was instructed to send a copy of the above to the family of Mr. Stickney.

Regular Meeting, Monday, Nov. 19, 1894.—Mr. Rantoul made a statement in reference to a cradle presented to the Institute by Richards W. Bradley of Boston. "The Essex Institute accepts with satisfaction the custody of an object so intimately associated with two of the most distinguished sons of Essex County, as is the cradle of

Joseph Story and William Wetmore Story. The list of their contributions to the fair fame of Salem, in politics, in literature, in good citizenship, in law and in art, is quite too extended to bear rehearsal here. Judge Story was born Sept. 18, 1779, in a mansion house in Marblehead now standing and nearly opposite the old Town House, and was there cradled in this quaint and interesting relic. In 1801, he came to Salem, building ten years later the house, now numbered 26 on Winter street, where he continued to reside until his removal to Cambridge in 1829; and in that house, on Feb. 12, 1819, the son was born whose genius as sculptor and author has kept the name of Story fresh in the regard of a second generation of Americans. No reminder of these two eminent men could be more suggestive to the people of this region by whom their fame is cherished than this cradle, and no place of deposit could be selected where it will be more sacredly cared for than in the Essex Institute." It was voted to adopt this statement as the sense of the members of the Institute and the Secretary was requested to record the same and forward a copy through Mr. Bradley to the Hon. Wm. W. Story at Rome, Italy.

Regular Meeting, Monday, Dec. 3, 1894, in Library room.—The Secretary gave some reminiscences of several old Salem schools, notably Master Lang's and Master Watson's; Mrs. Rogers', latter part of the last century; Mrs. Brown's; Misses Pierce's, Miss Haskell's, James S. Gerrish's, and the English High school down to about 1836. Specimens of penmanship of some of the old scholars 1791 to 1815, were exhibited, also receipts from old schoolmasters at various dates. This paper called forth quite a discussion, and among those who spoke on the subject in hand were President Willson, Mr. G. M. Jones, Mr. W. L. Welch and others.

Regular Meeting, Monday, Dec. 17, 1894, in Library room.—Papers were read by members of the Local History Class connected with the society: Mrs. H. W. Edwards on "Lady Deborah Moody;" Mrs. E. A. Kilham of Beverly on "Anne Hutchinson;" and Miss Helen D. Lander read a paper on "Hugh Peters," written by Miss Lucy W. Perry. These papers were well written and highly appreciated by the audience.

Remarks were made by the President and Hon. R. S. Rantoul in praise of what had been said.

Regular Meeting, Monday Evening, Jan. 7, 1895, in Library room.—Mr. John Robinson gave an account of the stone implements and other relics of the early native Indians of Essex County, with suggestions as to their age, origin and mode of manufacture. Specimens of stone implements, pottery, etc., from the Peabody Academy of Science were exhibited. Mr. Robinson was of the opinion, which he substantiated in some interesting remarks, that the stone relics must have been made not later than 1550, for the Indians would not have been likely to have made such articles after contact with Europeans, who visited these parts in the sixteenth century and could furnish them with iron or copper utensils and tools. Some of the implements may of course be much older.

Monday Evening, Jan. 14, 1895.—The first lecture in the "free course" was delivered this evening, in Plummer Hall, by Prof. T. C. Mendenhall, President of the Worcester Polytechnic Institute; subject, "The Seal Islands and the Bering Sea Controversy," illustrated with lantern views. The lecturer gave a brief account of the origin and present condition of the Bering Sea Controversy, mentioning incidentally that Bering, the discoverer of the straits, invariably spelt his name without the *h*. The gazetteers and geographies all spell the word

"Behring." He then spoke of the seal islands, discovered by a Russian named Publlof in 1786. Two of the group he named St. Peter and St. Paul. The Russians occupied the islands until they were sold with Alaska to the United States, in 1867, for $7,200,000. Professor Mendenhall said, that from these islands have already been reaped more money than was paid for the entire area of Alaska. The year after the U. S. bought it, over 250,000 seals were killed by poachers from all over the world. In 1871, a law was passed protecting seals, but the poachers took to killing them in the open sea, and before long their numbers became greatly diminished and an effort was made by the government to stop this, which eventually resulted in the "Bering Sea Controversy." The lecturer described his trip to the islands on a commission to obtain an estimate of the actual loss of seal life. Pictures were shown of seal life and of the natives of the islands. The lecturer stated that the seal would be extinct in a few years, unless in the near future some new and better plan than the arbitration provided, should be made for its protection.

Regular Meeting, Monday Evening, Jan. 21, 1895, at the Library room.—Mr. Herbert E. Valentine, a Salem boy, but now of Somerville, read an historical sketch of Company F, 23d Massachusetts Volunteers, organized in the fall of 1861, from the "Union Drill Club" of Salem. In introducing the speaker, Mr. Willson said it was appropriate that this paper should be read at a meeting of the Institute, as all the officers of the company and several of the members were more or less prominently connected with the Institute: Henry F. Waters, Dr. James A. Emmerton, F. H. Lee; and the commander of the corps, G. M. Whipple, was for years secretary of the Institute.

The company's life was traced by Mr. Valentine from its first camp on Winter Island (Camp Bertram) to the camp at Lynnfield, thence on its march through Boston, New York, Philadelphia and Perryville, where steamers were taken for Fortress Monroe. In January, 1862, the fleet sailed, the land forces under Gen. Burnside, the naval squadron under Commodore Goldsborough ; after a stormy and perilous time at Cape Hatteras, the troops landed at Roanoke Island. The speaker described, in vivid language, the engagements at this place, at Newberne, N. C., at later fights at Kingstown, Whitehall and Goldsboro. Ninety per cent of Co. F were Essex County men and seventy per cent from Salem alone.

Monday Evening, Jan. 28, 1895.—Dr. Richard Hodgdon, of Boston, lectured in Plummer Hall on "Unusual Hypnotic States." The lecturer began by saying that Hypnotism was the same as mesmerism, and mentioned recent French experiments in hospitals, in attempting to cure insanity and relieve mild delusions, which had been successful to a certain degree. He described the different states of consciousness which could be induced in the same persons at different times by the treatment—the individuals maintaining a concurrence of recollections and sentiments in each of the several states, quite independent of the other states.

Monday Evening, Feb. 4, 1895.—Regular meeting in the Library room. Mr. Frank Cousins gave an interesting and instructive talk on "The Old Houses of Salem," and events connected with them.

Monday Evening, Feb. 11, 1895.—Dr. George A. Dorsey, of Cambridge, lectured in Plummer Hall on "Peruvian Antiquities," illustrated with lantern views.

Pictures were shown of excavations made in a 40 acre lot, where 10,000 persons had been buried. The unearthing was made twenty-five years ago, in connection with the building of a railroad. Photographs of mummies were shown as they appeared partially exhumed, and with the natives working over the graves.

Monday Evening, Feb. 18, 1895.—Regular meeting at the rooms. Three interesting papers were read by members of the Local History Class of the Institute. One by Miss Abby Read on "Cats and Dogs" (of the olden time) was quite amusing; many of the old laws were given, together with anecdotes. The second paper was by Miss Mary S. Cleveland, on "South Fields" (South Salem), giving an interesting historic sketch of that part of the town in the early days, and the laying out of Lafayette street, by Mr. Derby and others. The third paper was by Mrs. R. C. Manning, on "Early Travel;" she spoke of the old roads and conveyances, giving particularly a sketch of a journey by Madam Knight, from Boston to New York and return, in 1740, which took about two months. The paper was full of curious and entertaining incidents. These papers were discussed by the President, Mr. Goodell, Mr. Rantoul, Mr. G. M. Jones, Mr. Welch and Rev. Dr. J. L. Hill.

Monday, Feb. 25, 1895.—C. Howard Walker, Esq., of Boston, lectured this evening in Plummer Hall, on the "Application of Architectural Ornamentation." He spoke of the beginning of Egyptian and Grecian architecture, and of the fine buildings abroad, where they had proper locations. He praised American enterprise, but thought our countrymen lacked good taste in architecture. School-houses are put up in lanes, and public buildings on side streets, when they should have more prominent

sites. He alluded to Boston's City Hall, on a street thirty six feet wide and the Court House up a lane; but improvement will come in time.

Monday, March 4, 1895.—Regular meeting this evening at the Library room. Professors E. S. Morse and John H. Sears spoke of Indian implements, pottery, shell heaps, etc. The former mentioned the measuring of a great number of clams from different shell heaps of Japan and America and of different periods, as showing age, etc. Mr. Sears thought the stones used by the Indians here for implements were of Essex County origin.

Monday, March 11, 1895.—Gamaliel Bradford, Esq., lectured this evening in Plummer Hall, on "Responsibility in Municipal Government." The lecturer had made a life-long study of the problems of government, and was therefore well qualified to speak on the subject. He favored the giving of more power to the executive and holding him strictly accountable for the proper conduct of city affairs, and he also favored single-headed commissions for the same purpose. All power to appropriate money should be vested in the aldermen, and should depend upon the advice of the city treasurer as to the disposal of the funds of a city.

Monday, March 18, 1895.—Regular meeting of the society this evening in the Library room. Miss Irene Weir, of Boston, read an exceedingly interesting paper on artistic "Posters." The fine collection, of Mr. Charles K. Bolton of the Brookline Public Library, was used for illustration. Miss Weir pointed out the many details which make a poster at once attractive and pleasing, and spoke of the various styles of French and American designers. A copy was shown of an early American printed

poster of 1797, with an engraving of an elephant, which was imported into this country in 1796, by a Salem vessel —the first elephant ever landed in America. Mr. J. D. H. Gauss exhibited a large Spanish poster, announcing a recent bull-fight.

Monday, March 25, 1895.—Hon. Geo. S. Hale, of Boston, lectured this evening in Plummer Hall, on "Why all citizens should vote." The speaker said that "unless a man is going to vote as he ought to, it is not his duty to vote at all." There is, he said, a growing tendency to hold the individual voters responsible, personally, for the faults and sins of mismanaged governments, but the voters throw the responsibility upon the party with which they are identified. Mr. Hale said that the evil of the day is the absurdity of submitting to the party in matters where the individual judgment should be exercised. A coterie of politicians, of either party, get together in some little room and pick out the "rascal" whom they think most likely to be elected, hold a "cut and dried" caucus to get him nominated, and the appeal is, to stand by the party. Until every voter is made to realize that he is to be held morally responsible, personally, for the well-being of his town, city, state or nation, in so far as he is able to express his choice of men and measures, politics will be as they are now, in a deplorable state. Men should vote independently, the lecturer said, without regard to party.

Monday, April 1, 1895.—Regular meeting this evening in the Library room. Hon. R. S. Rantoul read a very valuable and entertaining paper on the old Assembly House in Cambridge street, giving from deeds, documents, etc., a description of the building, of its size and general

appearance. In this building General Gage and Governor Hutchinson were entertained in 1774.

In the Assembly House in Federal St., built in 1782, Generals Washington and Knox attended a brilliant assemblage of ladies and gentlemen in Oct., 1789, when the President visited Salem.

Monday, April 8, 1895.—Hon. Charles Carleton Coffin, of Boston, lectured on "The Study of American History." He traced briefly the history of our own country, from its discovery by Columbus down to the present time, and showed how great events and important changes had often resulted from small things. He gave personal reminiscences of his experiences at Bull Run and Gettysburg, graphically describing those famous battles, and showing where comparatively small matters had very materially affected the results.

Monday, April 15, 1895.—A regular meeting of the society this evening in the Library room. The Secretary read a paper on the old localities about Salem. His remarks were of an historical nature, interspersed with anecdote. Among the localities mentioned were Button-hole, Knockers-hole, Norman St., Norman's rocks, old Eveleth house and vicinity, Creek Court, Broadfield, "Neighbor Thompson's" field or "Nauvoo," Circus Lane or Hathorne St., Wapping, Juniper, Hollingsworth Hill, Winter Island, Hospital Point, Bentley's rock, Gifford's Cave, Plank Alley or Elm St., Hawkes' Wharf or New Dublin, Seccomb's Wharf where anthracite coal was first sold in Salem (1826), Stage Point now site of Naumkeag Mills, Ship-yards in South Salem, Early ships, etc., Burying Point now Charter St. Cemetery (first burying place in Salem), Old Paved Street, Cheapside, "Nigger Huts" on Turnpike, Oliver's Cellar (site of Lynde Block),

Roast Meat Hill, Mill Hill, North and South fields, Wyman's Mills, Batchelder's Point, Leggs Hill, Dungeons, Throgmorton's Cove, Castle Hill, Baptist Hill, Hacker's, Chapman's and Dutch's corners, Cape Driver, Carltonville, Harmony Grove, Gallows or Witch Hill, Paradise, Peirce & Waite's Wharf, Blubber Hollow, Orne's Point, Kernwood, Liberty Hill and Cold Spring. Fish, Water, Neptune and County streets, Bath Street and Gutter Lane, Old Jail, Witchcraft Jail, Court and Marlborough Streets, Short Street, Sun Tavern, Essex Place, Dark Lane, Cowboy's Beach, etc. This paper was followed by a discussion participated in by the chairman, Hon. R. S. Rantoul, A. C. Goodell, Jr., W. L. Welch, John Robinson, Frank Cousins and others, and many interesting facts were brought out.

Monday, April 22, 1895.—Rev. J. M. Pullman, D.D. of Lynn, lectured in Plummer Hall on the "Administration of Public Charity." He spoke of the various ways in which charity is distributed and of the experience of many persons in alms-giving. He quoted several high authorities in the deprecation of public out-door relief, the evil being that it tends to degeneracy, and the relief only goes to the unworthy.

Monday, April 29, 1895.—Miss Lucia T. Ames, of Boston, lectured this evening in Plummer Hall, on "A more beautiful City Life," with lantern illustrations. Miss Ames spoke of the disfigurement of some of our American cities by the erection of high buildings—such, for instance, as one which is to be built on the site of the Tremont House in Boston, 135 feet high in a comparatively narrow street. These buildings shut out the light and sun, and make business for the oculist and physician, although they are considered works of enterprise. She

made a good argument against telegraph poles and spoke earnestly in favor of light, air and space, the establishment of playgrounds for children, and the laying out of parks for the people's use. She spoke of the decoration of the school-house and thought children should be taught the lines of beauty, so that when they grew up to be men and women, they would not permit ugliness in our streets, nor so much waste paper blowing about as we now see. She spoke of the laws on the subject of street cleanliness in our own and some foreign cities, especially Paris, which she praised. She exhibited on the screen fine views of prominent American and foreign buildings.

Monday, May 6, 1895.—Regular meeting this evening in the Library room. Prof. E. S. Morse announced by title an account of a new mineral called Fayalite, discovered for the first time in this county, at Rockport, by Mr. John H. Sears, of the Peabody Academy of Science.

Necrology of Members.

Lincoln F. Brigham, son of Lincoln and Lucy (Forbes) Brigham, was born in Cambridge ,Oct. 4, 1819 ; elected a member of the Essex Institute, Apr. 4, 1870 and died in Salem, Feb. 27, 1895.

Caleb Foote, son of Caleb and Martha (West) Foote, was born in Salem, Feb. 28, 1803 ; elected a member of the Essex Historical Society, Dec., 1842 and died in Milton, June 17, 1894.

Joseph W. Lefavour, son of David and Nancy (Foster) Lefavour, was born in Beverly, Mar. 11, 1836 ; elected a member of the Essex Institute, May 9, 1866 and died in Beverly, May 20, 1895.

John W. Masury, son of John and Priscilla (Carroll) Masury, was born in Salem, Jan. 1, 1820; elected a member of the Essex Institute, Mar. 4, 1895 and died in Centre Moriches, N. Y., May 14, 1895.

Daniel Needham, son of James and Lydia (Breed) Needham, was born in Salem, May 24, 1822; elected a member of the Essex Institute, Sept. 17, 1894 and died in Groton, Feb. 20, 1895.

Fitz W. Perkins, son of Jacob and Margaret (Collins) Perkins, was born in Gloucester, Aug. 20, 1844; elected a member of the Essex Institute, Aug. 10, 1894 and died in Washington, D. C., Sept. 30, 1894.

George A. Perkins, son of David and Hannah (Fabens) Perkins, was born in Salem, Oct. 15, 1813; elected a member of the Essex County Natural History Society, Jan., 1835 and of the Essex Institute, Nov. 21, 1849 and died in Salem, May 18, 1895.

George W. Pousland, son of Capt. John and Abigail (Derby) Pousland, was born in Beverly, May 13, 1814; elected a member of the Essex Institute, June 29, 1865 and died in Boston, Sept. 27, 1894.

Thomas E. Proctor, son of Abel and Lydia (Emerson) Proctor, was born in Danvers, Aug. 29, 1834; elected a member of the Essex Institute, Aug. 15, 1860 and died in Boston, Dec. 7, 1894.

Henry Saltonstall, son of Nathaniel and Caroline (Sanders) Saltonstall, was born in Salem, Mar. 2, 1828; elected a member of the Essex Institute, Mar. 11, 1857 and died in Boston, Dec. 3, 1894.

Leverett Saltonstall, son of Leverett and Mary E. (Sanders) Saltonstall, was born in Salem, Mar. 16, 1825;

elected a member of the Essex Historical Society, Apr. 21, 1821, of the Essex County Natural History Society in 1834, and of the Essex Institute, Jan. 4, 1854. He died in Newton, Apr. 15, 1895.

ANDREW A. SCOTT, son of Francis and Elizabeth (Miller) Scott, was born in Salem Nov. 9, 1832; elected a member of the Essex Institute, June 15, 1868 and died in Saugus, Dec. 17, 1894.

MATTHEW A. STICKNEY, son of Dudley and Elizabeth (Davis) Stickney, was born in Rowley, Sept. 23, 1805; elected a member of the Essex Historical Society, Dec. 1843, and of the Essex County Natural History Society, Jan. 17, 1846. He died in Salem, Aug. 11, 1894.

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Cincinnati, Ohio Mechanics' Institute,		1
Cincinnati (O.) Public Library,		2
Cincinnati (O.) Society of Natural History,		4
Cleveland, Lucy H.,	2	3
Cleveland (O.) Public Library,		9
Cleveland, O., Western Reserve Historical Society,		1
Colby, William R.,	1	
Cole, Caroline J.,	1	24
College Hill, Tufts College,		4
Columbia, Missouri Agricultural College,		1
Columbus, Ohio, Archæologist Publishing Company,		4
Columbus, Ohio State Board of Agriculture,		13
Conant, W. P.,	7	143
Concord, New Hampshire Historical Society,		2
Cope, E. D., Philadelphia, Pa.,		2
Cousins, Frank,	1	3
Creamer, George G., Beverly,	1	
Crowell, E. P., Amherst,		1
Curran, Stephen, Estate of,	28	
Cutter, Abram E., Boston,		1
Danvers, Peabody Institute,		1
Danzig, Naturforschende Gesellschaft,		1
Darmstadt, Verein für Erdkunde,		2
Daves, Graham, New Bern, N. C.,		1
Davis, Andrew McF., Cambridge,		1

Dawson, J. William, Montreal, Can., ...		1
Dayton, W. Hardy, ...		2
Dedham Historical Society, ...	4	4
Dedham Town Clerk, ...		1
Derby, Perley, ...		1
Des Moines, Iowa Academy of Science, ...	1	
Des Moines, Iowa Geological Survey, ...	1	
Detroit (Mich.) Public Library, ...		1
Dickson, W. S., ...	1	
Dijon, Académie Imperiale des Sciences, Arts et Belles-Lettres, ...		1
Dodge, Charles C., . . Newspapers and Circulars,		265
Dow, Geo. Frs., Topsfield, ...		18
Dreer, Ferdinand J., Philadelphia, Pa., ...	2	
Dresden, Naturwissenschaftliche Gesellschaft "Isis,"		2
Dublin, Royal Irish Academy, ...		7
Dublin, Royal Society, ...		8
Edes, Henry H., Charlestown, . . Newspapers,		6
Edinburgh Royal Society, ...		1
Egbert, Rev. John L., Marblehead, ...	1	
Ellis, Frank R., Cincinnati, O., ...		1
Ely, Theodore N., Philadelphia, Pa., ...	1	
Emden, Naturforschende Gesellschaft, ...	1	
Endicott, Charles, ...	1	
Erlangen, Physikalisch-medicinische Societat, . .		1
Ewing, Thomas, New York, N. Y., ...		2
Exeter, N. H., Phillips Exeter Academy, ...		1
Fabens, Caroline, ...		40
Falmouth, Royal Cornwall Polytechnic Society, . .		1
Fearing, A. C., Jr., Boston, ...	1	
Fewkes, J. Walter, Boston, ...		5
Firenze, Biblioteca Nazionale Centrale, ...		24
Firenze, Société Entomologique Italienne, ...		3
Folsom, A. A., Brookline, ...		1
Foster, John M., ...	1	
Frankfurt-a-M., Senckenbergische Naturforschende Gesellschaft, ...		3
Frear, William, State College, Pa., ...		4
Fribourg, Société Fribourgeoise des Sciences Naturelles,		5
Gardner, Mrs. Henry, ...	40	
Garrison, F. J., Boston, ... Newspapers.		
Gauss, John D. H., ... Newspaper.		
Genève, L'Institut National Genevois, ...		1
Gerould, Rev. S. L., Hollis, N. H., ...		3

Gilman, Emily S., Norwich, Ct., ...		1
Glasgow Archæological Society, ...		1
Glasgow, Baillie's Institution, ...		1
Gloucester City Clerk, ...	4	
Goodell, A. C., Jr., ...	21	9
Gottingen, K. Gesellschaft der Wissenschaften, . .		7
Grand Rapids (Mich.) Board of Trade, ...		1
Grand Rapids (Mich.) Public Library, ...		1
Grant, Misses, ...	55	
Granville, O., Denison University, ...		2
Gray, Miss A. A., Boston, ...		1
Green, S. A., Boston, ...	6	67
Gustrow, Verein der Freunde der Naturgeschichte, .		4
Halifax, Nova Scotian Institute of Science, . . .		1
Hall, J. D., and Company, ...		1
Hamburg, Naturwissenschaftlicher Verein, . . .		2
Hamburg, Verein für Naturwissenchaftliche Unterhaltung, ...		1
Hannover, Naturhistorischer Gesellschaft, . . .		1
Harlem, Musée Teyler, ...		2
Harlem, Société Hollandaise des Sciences, . . .		7
Harris, Mrs. Robert, New York, N. Y., ...		2
Hartford (Ct.) Board of Trade, ...		1
Hartford, Connecticut Historical Society, . . .	1	1
Hartford, Connecticut Quarterly Company, . . .		2
Hartford, Ct., School of Sociology, ...		3
Hartford, Ct., Trinity College, ...		1
Hassam, John T., Boston, ...	1	
Hazen, Rev. Henry A., Auburndale, ...		1
Helena (Mont.) Public Library, ...		8
Herrick, C. L., Granville, O , ...		4
Hill, Rev. James L., ... Circulars,		4
Hoadley, Charles J., Hartford, Ct., ...	1	
Hoar, George F., Worcester, ...		2
Hooper, N. M., ...		1
Hotchkiss, Miss S. V., New Haven, Ct., Newspapers.		
Houghton, Michigan Mining School, ...		1
Howson, Hubert, New York, N. Y., ...		1
Hunt, T. F., ...	29	117
Huntington, Ind., Free Library of Public Schools, .		1
Iowa City, Iowa State Historical Society, . . .		7
Iowa City, State University of Iowa, ...		1
Ithaca, N. Y., Cornell University, ...		3
Jersey City (N. J.) Free Public Library, .		13

Johnson, Edward F., Woburn, ...	2	
Johnson, Thomas H., ...		221
Jones, C. C., Rockford, Ill., ...		1
Kassel, Verein für Naturkunde, ...		1
Keith, Charles P., Philadelphia, Pa., ...	1	
Kelton, Dwight H., Montpelier, Vt., ...		2
Kimball, F. R., ...	6	10
King, Horatio C., New York, N. Y., ...		1
Kjöbenhavn, K. D. Videnskabernes Selskabs, . .		3
Kjöbenhavn, Nord Oldkyn og Historie, ...		3
Königsberg, Physikalisch-Okonomische Gesellschaft, .		1
Lambert, Laura, Estate of, ...	76	12
Lamson, Frederick, ... Newspapers,		9
Lancaster Town Library, ...		1
Lander, Helen D., ...	1	
Lanier, Mrs. Charles, New York, N. Y., . . .	1	
Lansing, Michigan State Library, ...	2	
Lausanne, Société Vaudoise des Sciences Naturelles, .		2
Lawrence, Kansas University, ...		4
Leach, Josiah G., Philadelphia, Pa., ...	1	
Leavens, Rev. P. F., Passaic, N. J., ...		1
Lee, Francis H., ... Newspapers,		77
Lee, Mrs. Francis H., ... Newspapers,	1	204
Lee, L. A., Brunswick, Me., . . . Circulars,		4
Leiden, Rijks-Universiteit, ...		3
Leipzig, K. S. Gesellschaft der Wissenschaften, . .		2
Le Mans, Société d'Agriculture, Sciences et Arts, . .		2
Lincoln, Nebraska Historical Society, ...		2
Lincoln, University of Nebraska, ...		1
London Geological Society, ...		5
London, Royal Geographical Society, ...		12
London, Royal Society, ...		15
London, Zoological Society of, ...		6
London, Entomological Society of Ontario, . . .		13
Loring, Caleb W., Pride's Crossing, ...	1	
Los Angeles (Cal.) Public Library, ...		1
Lund, Kongliga Universitetet, ...		2
Lundy, Mrs. J. P., Philadelphia, Pa., ...		2
Luxembourg, L'Institut Grand Ducal, ...		1
Lyon, Académie des Sciences, Belles-Lettres et Arts, .	1	1
Lyon, Société d'Agriculture, Science et Industrie, . .		1
Lyon, Société Linnéenne, ...		3
Mack, William, ...		55
Madison, University of Wisconsin, ...		1

Madrid, Observatorio de, ...	1	
Manchester (Eng.) Literary and Philosophical Society,		5
Manchester (N. H.) Public Library, ...		1
Manning, Richard C., ... Newspapers.		
Marburg, Gesellschaft zur Beförderung des Gesammten Naturwissenschaften, ...		1
Massachusetts Board of World's Fair Managers, . .	1	
Massachusetts, Secretary of the Commonwealth of, .	15	
Meek, Henry M., ...	3	1
Meigs, John, Pottstown, Pa., ...		1
Michigan Agricultural College, ...		12
Milwaukee, Wis., Public Museum of, ...		1
Minneapolis, Geological and Natural History Survey of, Minnesota, ...	1	1
Minneapolis (Minn.) Public Library, ...		1
Montpelier, Vermont State Library, ...	11	12
Montreal Natural History Society, ...		3
Moore, C. B., Philadelphia, Pa., ...	3	
Moore, David, ...	1	
Morris, John E., Hartford, Ct., ...	1	1
Morris, Seymour, Chicago, Ill., ...		1
Morse, E. S., ... Newspapers,		11
Moscou, Société Imperiale des Naturalistes, . .		4
Mowry, William A., Hyde Park, ...		1
Moynahan, Frank E., Danvers, ...		1
Munchen, Bayerische Botanische Gesellschaft, . .		1
Munchen, D. Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, ...		8
Munchen, K. B. Akademie der Wissenschaften, . .		10
Nahant Town Clerk, ...		1
Napoli, Accademia delle Scienze Fisiche e Matematiche,		7
Nashville, Tennessee State Board of Health, . .		13
Neuchatel, Société des Sciences Naturelles, . . .		4
Nevins, W. S., ...	10	1
New Brighton, N. Y., Natural Science Association of Staten Island, ...		22
New Brunswick, New Jersey State Microscopical Society, ...		1
New Haven (Ct.) Colony Historical Society, . .	1	
New Haven, Ct., Yale University, ...	1	4
New York (N. Y.) Academy of Sciences, . . .		6
New York, N. Y., American Geographical Society, .		5
New York, N. Y., American Museum of Natural History,		8
New York, N. Y., American Numismatic and Archæological Society, ...		1

New York, N. Y., Astor Library, ...			1
New York (N. Y.) Central and Hudson River Railroad,			1
New York (N. Y.) Chamber of Commerce, . . .		1	
New York (N. Y.) Genealogical and Biographical Society, ...			4
New York (N. Y.) Historical Society, ...		1	1
New York, N. Y., Lenox Library, ...			2
New York, N. Y., Linnean Society of, ...			1
New York, N. Y., Mercantile Library of, . . .			1
New York (N. Y.) Microscopical Society, . . .			4
New York, N. Y., Scientific Alliance of, . . .			1
Nichols, Andrew, Bridgewater, N. H., ...			1
Nichols, John H., ...	Map,	2	
Northampton, Smith College, ...			1
North Andover Town Clerk, ...			1
Northend, William D., ...		12	3
Nourse, Dorcas C., ...	Newspapers.		
Nürnberg, Naturhistorische Gesellschaft, . . .			1
Oliver, Mrs. Grace A., ...	Newspapers,		7
Ottawa, Royal Society of Canada, ...		1	
Palfray, Arthur S., ...			1
Palo Alto, Cal., Leland Stanford Junior University, .			1
Paris, Journal de Conchyliologie, ...			4
Paris, Museum d'Histoire Naturelle, . , . .			2
Paris, Société d' Anthropologie, ...			4
Paris, Société des Etudes Historiques, ...			1
Paris, Société Entomologique de France, . . .			20
Paris, Société Geologique de France, ...			6
Paris, Société Nationale d'Acclimatation, . . .			24
Parker, William, ...			8
Parson, Lewis B., Flora, Ill., ...			1
Peabody, Peabody Institute, ...			1
Pearson, H. G., Memorial Committee, New York, N. Y.,			1
Peet, Rev. S. D., Granville, O., ...			6
Perkins, George A., ...		1	
Perkins, John W., ...			1
Perley, M. V. B., Ipswich, ...			9
Philadelphia, Pa., Academy of Natural Sciences, .			3
Philadelphia, Pa., American Academy of Political and Social Science, ...			1
Philadelphia, Pa., American Philosophical Society, .			3
Philadelphia (Pa.) City Institute, ...			1
Philadelphia, Genealogical Society of Pennsylvania, .			1
Philadelphia, Historical Society of Pennsylvania, . .			4

Philadelphia, Pa., Indian Rights Association,			3
Philadelphia (Pa.) Library Company,			2
Philadelphia, University of Pennsylvania,			1
Philbrick, Eliza and Helen,	Newspapers,		10
Phillips, Stephen H.,			3
Pickering, John,		47	
Piper, Horace, Washington, D. C.,		1	
Pittsburgh, Historical Society of Western Pennsylvania,			1
Pool, Wellington, Wenham,			3
Poole, Murray E., Ithaca, N. Y.,		1	
Porter, Rev. Aaron,	Newspapers,	2	
Portland, Maine Genealogical Society,			20
Portland, Maine Historical Society,			4
Portland, Ore., Library Association of,			23
Port-of-Spain, Victoria Institute,			2
Powell, Lyman P., Washington, D. C.,	Newspapers,		2
Prague, K. K. Sternwarte,			1
Pratt, Henry J.,		19	84
Preston, Charles H., Danvers,		1	2
Prime, Ralph E., Yonkers, N. Y.,			1
Prime, Temple, Huntington, N. Y.,		1	7
Princeton (N. J.) College,			4
Providence, R. I., American Humanitarian League,		1	
Providence, R. I., Brown University,			1
Providence (R. I.) Public Library,			7
Providence, Rhode Island Historical Society,			4
Providence (R. I.) Record Commissioners,		2	1
Putnam, Rev. A. P., Concord,			1
Putnam, Eben,		10	21
Putnam, F. W., Cambridge,	Newspapers,		11
Quebec, L'Université Laval,			1
Ramsay, Rev. William H.,		7	
Rantoul, Robert S.,	Newspapers,	5	12
Regensburg, Naturwissenschaftlicher Verein,			1
Reynoldsville (Pa.) Volunteer,			1
Rhode Island Commissioner of World's Fair,		1	
Rich, George, Columbus, O.,			1
Rich, Mrs. Snow,	Newspapers,	8	4
Richmond, Virginia Historical Society,			2
Riga, Naturforschende Verein,			1
Ripley, Charles S., U. S. Navy,		1	
Robinson, E. P., Hamilton,		1	
Robinson, John,			28
Robinson, Mary F.,		1	16

Rochester (N. Y.) Academy of Science, . . .		1
Rugg, Arthur P., Worcester, ...		1
Sacramento, California State Library, . . .		1
St. Gallen, Naturwissenschaftliche Gesellschaft, .		2
St. John, Natural History Society of New Brunswick,		1
St. Louis, Mo., Academy of Science, ...		6
St. Louis, Missouri Botanical Garden, ...	1	
St. Louis (Mo.) Mercantile Library Association, . .		1
St. Louis, Missouri Historical Society, . . .		8
St. Paul, Minnesota Historical Society, ...	1	3
St. Pétersbourg, Academie Imperiale des Sciences, .		24
St. Petersbourg, Societatis Entomologica, . . .		1
Salem, Associated Charities of, ...		1
Salem Board of Health, ...		1
Salem Custom House Collector, ...		1
Salem, First National Bank, ...	28	
Salem, Peabody Academy of Science, Newspapers and Circulars, ...	1	88
Salem Public Library, ...	1	14
Saltonstall, Leverett, Boston, ...		1
San Diego, Cal., West American Scientist, . . .		7
Sanford, H. H., Syracuse, N. Y., ...		1
San Francisco, California Academy of Sciences, .		1
San Francisco (Cal.) Board of Supervisors, . .	1	
San Francisco (Cal.) Free Public Library, . . .		2
San Francisco (Cal.) Mercantile Library Association, .		1
San Francisco, California State Mining Bureau, . .		1
Santiago, Société Scientifique du Chili, . . .		1
Saunders, Mary T., ...	9	32
Savage, James F., Lowell, ...	1	
Sayward, C. A., Ipswich, ...		3
Scudder, Samuel H., Cambridge, ...		1
Sears, John H., ...		1
Shanghai, China Branch of Royal Asiatic Society, .		1
Shirley, George H., Brooklyn, N. Y., ...		1
Silsbee, Mrs. William, ...		1
Snowdon, W. H., Arcturus, Va., ...		1
Somerville Public Library, ...		1
South Boston, Church Home for Orphan and Destitute Children, ...		1
South Boston, Perkins Institution and Massachusetts School for the Blind, ...		1
Springfield, Illinois State Board of Agriculture, . .		1
Springfield, Illinois State Museum of Natural History,		3

Springfield City Library Association, ...		3
Start, Rev. William A., Tufts College, . . .		1
Stavanger Museum, ...		1
Stearns, John P., Santa Barbara, Cal., . . .		2
Stettin, Entomologischer Verein, ...		3
Stimpson, T. M., Peabody, . . . Newspapers.		
Stockholm, Académie Royale des Sciences, . .	4	8
Stockholm, Entomologique Föreningen, . . .		2
Stone, Arthur R., ...		1
Stone, Joseph W., ...	3	
Streeter, Gilbert L., ...	164	703
Sydney, Department of Agriculture of New South Wales,		1
Sydney, Linnean Society of New South Wales, . .		5
Sydney, Royal Society of New South Wales, . .		2
Tacoma, Washington State Historical Society, . .		1
Taunton, Old Colony Historical Society, . . .		3
Taunton, Somersetshire Archæological and Natural History Society, ...		1
The Babcock and Wilcox Company, New York, N. Y., .	3	
The Hague, Nederlandsche Entomologische Verein, .		6
The Werner Company, Chicago, Ill., ...		1
Throndhjen, K. Norske Videnskabernes-Selskab, .		2
Todd, William C., Atkinson, N. H., ...	1	3
Tokio, Imperial University of Japan, ...		1
Topeka, Kansas State Historical Society, Newspapers,		1
Tromso Museum, ...		2
Turner, J. Horsfall, ...		1
Turner, Ross, ...	3	3
U. S. Bureau of Education, ...	2	5
U. S. Bureau of Ethnology, ...	4	7
U. S. Bureau of Statistics, ...	3	3
U. S. Census Office, ...		1
U. S. Chief of Ordnance, ...	1	
U. S. Civil Service Commission, ...	1	
U. S. Coast and Geodetic Survey, ...	1	3
U. S. Commissioner of Labor, ...	1	
U. S. Commissioner of Patents, ...		1
U. S. Committee on Finance, ...		52
U. S. Department of Agriculture, ...	6	433
U. S. Department of Interior, ...	162	25
U. S. Department of State, ...		13
U. S. Director of the Mint, ...		1
U. S. Fish Commission, ...	3	
U. S. Geological Survey, ...	10	20

U. S. Interstate Commerce Commission, ...	1	
U. S. Judge-Advocate General, ...		1
U. S. Life-Saving Service, ...	1	
U. S. Naval Observatory, ...		1
U. S. Patent Office, ...		58
U. S. Quartermaster-General, ...	1	
U. S. Secretary of the Treasury, ...	2	
U. S. Surgeon-General, ...	1	
U. S. War Department, ...	147	28
Upham, William P., Newtonville, ...		2
Upsal, K Vetenskaps-Societeten, ...		1
Walker, Joseph B., Concord, N. H., ...	1	
Waltham, Massachusetts School for the Feeble Minded,		1
Walton, J. P., Muscatine, Ia., ...		2
Washington, D. C., American Forestry Association, .		3
Washington, D. C., Anthropological Society, . .		4
Washington, D. C., Microscopical Publishing Company,		13
Washington, D. C., Smithsonian Institution, . .	3	4
Waterloo, Ind., Archæologist Publishing Company, .		12
Waters, E. S., Minneapolis, Minn., ...		1
Waterville, Me., Colby University, ...		2
Watson, S. M., Portland, Me., ...		1
Webber, C. H., Boston, ...		2
Welch, William L., ...	12	96
Wellesley, Wellesley College, ...		1
West, Edward W., Brooklyn, N. Y., ...		1
Wheatland, Elizabeth, ... Newspapers,		30
Wheatland, Henry, Estate of, ...	1	
Wheeler, W. O. and E. D. Halsey, Morristown, N. J., .		1
Whipple, George M., ...		8
Whitney, Mrs. H. M., North Andover, Newspapers and Maps, ...	1	173
Wien, K. Akademie der Wissenschaften, . . .	1	24
Wien, K. K. Geologische Reichsanstalt, . . .		20
Wien, K. K. Naturhistorische Hofmuseums, . .		4
Wien, K. K. Zoologisch-botanisch Gesellschaft, . .		4
Wien, Verein zur Verbreitung Naturwissenschaftlicher Kenntnisse, ...		1
Wiesbaden, Nassauischer Verein für Naturkunde, .		1
Wilkes-Barré, Pa., Wyoming Historical and Geological Society, ...		3
Williams, Mrs. Henry L., . . . Newspapers.		
Williams, Tucker D., . Newspapers and Circulars,	25	33
Williamsburg, Va., William and Mary College, . .		2

Willson, Rev. E. B., ...	Newspapers,		151
Wilson, Fred A., Nahant, ...		1	
Winnipeg, Historical and Scientific Society of Manitoba, ...			4
Winsor, Justin, Cambridge, ...			35
Winthrop, Robert C., Jr., Boston, ...		1	
Worcester, American Antiquarian Society, . . .			3
Worcester Society of Antiquity, ...			3
Wright, Frank V., Hamilton, ...		1	120
Wurzburg, Physikalisch-Medicinische Gesellschaft, .			17
Yates, Lorenzo G., Santa Barbara, Cal., . . .		1	
Zeballos, E. S., Argentine Minister, Washington, D. C.,			3
Zurich, Naturforschende Gesellschaft, ...			3

The following have been received from editors and publishers:

American Journal of Science.
American Naturalist.
Beverly Citizen.
Cape Ann Advertiser.
Chicago Journal of Commerce.
Danvers Mirror.
Engraver and Printer.
Georgetown Advocate.
Groton Landmark.
Home Market Bulletin.
Iowa Churchman.
Ipswich Independent.
Lawrence American.
Le Naturaliste Canadien.
Lynn Item.
Lynn Transcript.
Marblehead Messenger.
Musical Record.
Nation.
Nature.
Open Court.
Peabody Advertiser.
Peabody Press.
Salem Gazette.
Salem News.
Salem Observer.
Salem Register.
The Citizen.
Traveler's Record.
Voice.
Zoologischer Anzeiger.

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Barton, James W., Danvers.
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Curtis, George, Boxford.
Curwen, George R.
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Doherty, E. W.
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Felt, John.
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Gauss, J. D. H.
Goodell, Zina.
Gould, John H., Topsfield.
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Harrington, Richard B.
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Hoar, E. R., Concord.
Hobbs, Henry, Wenham.
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Hubon, Henry G.
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Hyatt, Alpheus, Cambridge.
Johnson, Daniel H., New York, N. Y.
Johnson, Thomas H.
Kilham, Mrs. Edward, Beverly.
Kimball, Sarah S.
Kinsman, Mrs. William L.
Knight, Mrs. Edward H.
Lamson, Frederick.
Lander, Helen D.
Lander, Louisa.
Lander, Mrs. William A.
Lee, Francis H.
Lee, Mrs. Francis H.
Little, David M.
Low, Daniel.
Mack, William.
Merchant, George E., Gloucester.
Monroe, Minerva B., Lynn.
Moore, David.
Morse, Edward S.
Morse, N. R.
Narbonne, Mary A.
Newhall, James R., Estate of, Lynn.
Northend, William D.
Norton, Thomas H., Warren, Me.
Osborne, H. Frances.
Osgood, Mrs. Charles S.
Peabody Academy of Science.
Philbrick, Helen and Eliza.
Phillips, Mrs. S. H.
Phippen, George D.
Pickering, John.
Putnam, Eben.
Rantoul, Hannah L., Beverly.
Rantoul, Robert S.
Richardson, Edward S. L., Aurora, Ill.
Robinson, John.

Robinson, Mary.
Russell, William.
Salem Marine Society.
Salem Water Board.
Saunders, Mary T.
Silsbee, Mrs. William.
Skinner, John B.
Smith, Augustus A.
Smith, George P., Philadelphia, Pa.
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Spear, Charles F., Peabody.
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Stone, Joseph W.
Stone, Lincoln R., Newton.
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Thomas, Jean.
Tileston, Mrs. J. B., Mattapan.
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Wiggin, Emma.
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BULLETIN

OF THE

ESSEX INSTITUTE.

Vol. 27. Salem: July—December, 1895. Nos. 7–12.

THE LUMBAR CURVE IN SOME AMERICAN RACES.

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INTRODUCTION.

The human vertebral column in profile presents two sets of curves: the primary, or dorsal and sacral curves; and the secondary, or cervical and lumbar curves. The secondary curves are preëminently human characteristics and are not acquired by the individual until after birth. Furthermore, the secondary curves are essential to the upright gait, and of the two, the lumbar is the more important. Investigation has shown that the curvature of the lumbar region varies according to age, sex and race. It has also been shown that the lumbar curve is not an

exclusively human characteristic, but that it prevails to a greater or less extent in the anthropoid apes and is anticipated at least in some of the quadrupedal mammals.

Up to the present time investigations upon the character of the lumbar curve in man have been pretty exclusively confined to Europeans and the peoples of the Pacific and Indian Oceans; scarcely any observations have been made, so far as I know, on the spines of aboriginal Americans.

To attempt to supply this omission is the motive of this paper. But, before turning to a direct examination of the material in hand, it may not be out of place to sum up the results of former investigators in this field.

The literature at my immediate command is not such as to enable me to attempt anything like a complete history of the observations on the lumbar curve, and I can only mention the most important papers on the subject.

In 1886, two papers, each preceded by an abstract, appeared on the lumbar curve. The first was by Professor D. J. Cunningham of Dublin, in "Nature" (issue of February 18th). This was an abstract of his researches which were published in full in the same year under the title "The Lumbar Curve in Man and Apes" (Dublin, "Cunningham Memoirs," II, 1886). The other paper was by Professor W. Turner of Edinburg in the April number of the "Journal of Anatomy and Physiology." In the same year appeared Vol. XVI of the "Challenger Reports," in which Turner not only investigated the curve in the skeletons collected by the Challenger expedition, but incorporates also, to some extent, the results obtained by Cunningham.

The acquisition of the fresh spine of an aboriginal Australian was made the subject of another paper by

Cunningham before the Royal Society in 1888, which was printed in full in Vol. 45 of the "Proceedings."

Other writers on this subject have been Huxley, Symington, Ravenel and Aeby. The brothers Sarasins have reported the results of their investigations of the curve among the Veddahs in their invaluable work "Die Weddas von Ceylon." (Wiesbaden, 1893).[1]

In all of the above investigations the method of procedure is as follows. The anterior and posterior vertical depth of each vertebral body is measured separately. The anterior depth is taken as 100 and so the index of each vertebra can be obtained. By taking the sum of the anterior depths and the sum of the posterior depths the *Lumbo-vertebral* or *Lumbar Index* is obtained by this formula:

$$\frac{\text{Sum of posterior measurements} \times 100}{\text{Sum of anterior measurements}} = \text{Index}$$

The index, thus obtained, will be 100, when the sum of the posterior measurements equals the sum of the anterior measurements; less than 100, when the sum of the anterior measurements exceeds the sum of the posterior; and more than 100 when the opposite condition prevails.

To these three conditions Turner has applied the following terms: Orthorachic (straight spine) Index 98–102, Kurtorachic (curve convex forwards) Index 98—, Koilorachic (curve concave forwards) Index 102+.

To illustrate the method of procedure, I give the measurements of the lumbar vertebræ of the spine of a European which may be regarded as fairly typical.

[1] A complete bibliography of the lumbar spine is to be found in the Cunningham Memoir, pp. 113–116.

	ANTERIOR DEPTH. MM.	POSTERIOR DEPTH. MM.	INDEX.
I. Lumbar Vertebra . . .	27	28	103.6
II. Lumbar Vertebra . . .	27	27	100.0
III. Lumbar Vertebra . . .	27	25	92.5
IV. Lumbar Vertebra . . .	26	24	92.3
V. Lumbar Vertebra . . .	28	20	71.4
Total	135	124	90.3

On analyzing this table it appears that in the first vertebra, in this particular instance, the anterior measurement exceeds that of the posterior, which is contrary to the general rule in Europeans; the anterior and posterior depths are equal in the second vertebra; while in the remaining vertebræ the anterior depth increases more and more proportionately to the posterior depth until in the fifth vertebra the anterior depth exceeds the posterior in a very marked manner.

This it is which gives rise to the wedge-shape appearance in the last lumbar so typical in European spines; and which, as Cunningham has pointed out, is not found in so marked a degree in the lower races.

For the purpose of future comparisons and for the reason that the original papers of Turner and Cunningham are not always easily accessible in this country, I take the liberty of reproducing here the most valuable portions of their observations.

It will be seen at once that the results in the two tables correspond very closely except in case of the Andamanese and Negroes. In the case of the low index (99) assigned to the Andamanese in Turner's table, it is

TABLE I (CUNNINGHAM).

		76 EUROPEANS.	17 AUSTRALIANS.	3 TASMANIANS.	3 BUSHMEN.	23 ANDAMANESE.	10 NEGROES.
Five Lower True Vertebræ	*a*	106.1	119.8	115.1	115.9	112.6	113.5
	b	101.4	113.0	109.9	113.4	111.2	111.3
	c	97.2	113.6	110.1	109.9	108.1	105.9
	d	93.5	103.9	109.5	100.8	102.6	105.1
	e	81.6	90.4	92.4	95.3	91.4	92.0
Lumbo-vertebral Index		95.8	107.8	107.2	106.6	104.8	105.4

TABLE II (TURNER).

		12 EUROPEANS.	5 AUSTRALIANS. 4♀, 1♂.	2 ANDAMANESE.	3 NEGROES. 2♀, 1♂	3 DAHUANS, SANDWICH ISLANDS.
Index of Lumbar Vertebræ	I	106.8	114.4	119.3	108.8	114.6
	II	101.5	112.3	105.6	104.2	108.0
	III	95.4	108.0	102.0	100.0	108.2
	IV	93.0	103.7	91.8	93.0	101.5
	V	83.6	91.4	84.2	89.0	87.7
Mean Average Index		96.0	105.96 =106.0	98.98 =99.0	99.0	104.0

probably to be explained by the fact that both subjects measured were females. This explanation is also manifestly good for explaining the difference between the two sets of figures for the Negroes, for in Turner's tables two of the three Negroes measured were females.

Cunningham investigated the influence of sex on the curve and found a difference of .03 approximately, in those races which he studied. Here are his results:

TABLE III (CUNNINGHAM).

	IRISH.		ANDAMANESE.		NEGROES.	
	21 ♂	23 ♀	14 ♂	9 ♀	7 ♂	3 ♀
Average Lumbar Index . .	96.2	93.5	106.3	102.4	106.	103.4

	AUSTRALIANS.		TASMANIANS.	
	10 ♂	4 ♀	2 ♂	1 ♀
Average Lumbar Index	110.1	103.1	108.5	104.7

We now come to the question of the relation of the umbar index to the lumbar flexure in the living subject. Cunningham reached the conclusion that practically there could be no inference as to the character of the curve from lumbo-vertebral index. The facts which led him to adopt this conclusion were:—

1. "In European spines a high index is not infrequently associated with a high degree of curvature.

2. In the chimpanzee, in which the lumbo-vertebral index is so high as 117.5, the prominence of the lumbar curve exceeds that found in the European spine."

Cunningham has further concluded that "the form adaptation of the vertebral bodies must be regarded as the consequence, and not as a cause, of the curve; at the same time it cannot be due to an immediate and mechanical influence operating upon the vertebral bodies during the life of the individual. If it were so, the same characters would be present in the lumbar vertebræ of the low races, and even of the anthropoid apes. It is an hereditary condition."

As to the causes of such great variations among different races Cunningham says—"The European, who leads a life which early necessitates his forsaking the erect attitude, except as an intermittent occurrence, and then for short periods, has sacrificed in the lumbar part of the vertebral column *flexibility* for *stability*. It is evident that the deeper the bodies of the vertebræ grow in front, the more permanent, stable and fixed the lumbar curve will become, and the more restricted will be the power of forward-bending in this region of the spine.

The savage, in whose life agility and suppleness of body are of so great an account, who pursues game in a prone condition, and climbs trees for fruit etc., preserves the anthropoid condition of vertebræ, and in consequence possesses a superior flexibility of the lumbar part of the spine."[1]

In 1888, in a paper by Cunningham, the title of which has already been given, he carried his investigations still farther by examining the fresh spine of an Australian girl, a full account of which is there given. In this he investigates the indices of the intervertebral disks. The results are self-explanatory and show at once the determining factor in the curve of the living individual.

[1] "Nature," Feb. 18, 1886, p. 379.

TABLE IV.

	INDEX OF VERTEBRAL BODIES.	INDEX OF INTERVERTEBRAL DISKS.
Australian Spine, ♀	101.4	49.5
European Spine, ♀	91.0	80.3

THE LUMBAR CURVE IN AMERICAN RACES.

The skeletons examined for the preparation of this paper come from the following localities :

I. North-west Coast Indians, 36 :
 1. Songish, seven males, seven females.
 2. Kwakiutl, seven males, ten females.
 3. Chinook, one male, four females.

II. Iroquois, two males, one female.

III. Mounds of Ohio, 22 :
 1. Oregonia, four males, two females.
 2. Fort Ancient, ten males, six females.

IV. Peru, 35 :
 1. Ancon, fifteen males, fourteen females.
 2. Cuzco, four males, two females.

The skeletons from the North-west Coast, except the Chinook, were collected by Dr. Franz Boas. The Chinook skeletons are from old graves on the upper Columbian River, and were collected by Mr. D. Scott Moncrieff. The Iroquois skeletons were collected by F. M. Noe from ancient graves in New York State. All of the Ohio skeletons were collected by Mr. W. K. Moorehead. Those from Oregonia are from a mound on the Taylor Farm, and those from Fort Ancient, from the village site. The Peruvian skeletons from Ancon were

collected by the writer, and those from Cuzco were collected by Sr. Emelio Montez in the tombs at Huaracondo, near Cuzco.

I greatly regret that other localities are not represented by sufficient material in this Museum so that the paper might be made more complete. It will be evident, however, that at least three regions, widely separated from each other, are well represented.

It is believed that the material from the North-west Coast is sufficient to enable us to draw conclusions which shall be applicable to that entire region.

The Ohio material may be regarded as typical of the older populations of the Ohio Valley. Whether it will be found to be similar to that of the modern red-skins of the Ohio Valley and of the eastern United States in general remains to be seen—the number of Iroquois skeletons examined not being sufficiently large to enable us to draw any satisfactory conclusion.

The two peoples of ancient Peru, the Yuncas of the coast and the Quichuas of the interior plains and valleys, are fairly well represented; the former it is believed to an extent quite satisfactory.

Observations on the lumbar curve among the peoples of the east coast of South America are especially desirable, for it seems to me not unlikely that the results from that region may equal or even surpass those of Australia in the height of the lumbo-vertebral index. It may be further stated that only the spines of normal adults, unless otherwise indicated, have been used in the preparation of this paper.

I. North-west Coast tribes:

1. KWAKIUTL. TABLE V. SEVEN MALES, TEN FEMALES.

Kwakiutl	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	117.8	110.1	109.8	99.9	88.7	105.0
Females	111.2	106.8	100.8	90.7	84.3	98.1
Both sexes , ...	114.5	108.4	105.3	95.3	86.5	101.5

The average total of the sum of the anterior depths in the males is 125 mm., the highest single sum being 135 mm., the lowest, 118 mm.; of the sum of the posterior measurements, the highest is 143 mm., lowest 125 mm., mean average 132 mm. In the females the highest anterior sum is 136 mm., the lowest 119 mm., mean average 128 mm.; posterior sums, highest 138 mm., lowest 119 mm., mean average 126. Of the mean general index for the males the highest 110, the lowest 101.6; for the females the highest 105, the lowest 90.3. It is interesting to note that although the gap separating the index of males from the females is considerable, yet no general male index falls below 100, while forty per cent. of the females indices are above 100.

2. SONGISH. TABLE VI. SEVEN MALES, FIVE FEMALES.

Songish	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	115.7	111.6	107.9	96.5	82.5	102.2
Females	111.3	108.	102.	92.	82.8	99.1
Both sexes	113.5	108.8	104.9	94.5	82.6	100.6

Of this mean general index of 100.6 it is worth while to note that in only one instance does any male index fall below this figure; while no female index equals it. In fact the range in both sexes among the Songish is very slight, the highest index in the males being 104.7, and in the females the lowest is 98.2. The sum of the anterior measurements in the males averages 126 mm.; the maximum being 150 mm., the minimum 115 mm.

3. CHINOOK. TABLE VII. ONE MALE, FOUR FEMALES.

Chinook	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	116.	115.2	111.5	103.6	80.	104.4
Females	107.1	103.9	99.8	89.5	85.5	98.7
Both sexes	111.5	109.5	105.6	96.5	82.7	101.5

Of course it is barely possible that the mean general index, 101.5, would be slightly raised if there had not been such a disproportionately large number of females to the males; but a larger number of measurements of the spines of both sexes would not, in all probability, have raised the index above 102.

The variations in the four Chinook females are very slight, the highest general index being 100, the lowest 97.7. The average sum of the anterior measurements in the male is 134 mm., of the posterior 140 mm. The average sum of the anterior measurements of the females is 127 mm.; the highest being 137 mm., the lowest 126 mm. Of the sum of the posterior measurements, the average is 125 mm., the highest being 127 mm., and the lowest 120 mm.

II. Iroquois:

TABLE VIII. TWO MALES, ONE FEMALE.

Iroquois	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	110.	108.	105.6	102.9	94.4	105.
Females	112.5	108.	100.	92.5	74.	96.8
Both sexes	111.1	108.	102.8	97.7	84.2	100.9

The sum of the anterior measurements of the lumbar vertebræ in the two males is 128 mm., and 129 mm., the sum of the posterior measurements 131 mm., and 139 mm.; similar measurements in the female are 129 and 125 mm. In both males the anterior depths of the first, second, third and fourth lumbars are less than the posterior depths; in the female this is true of the first three vertebræ only.

III. Mounds of Ohio:

1. OREGONIA. TABLE IX. SEVEN MALES.

Oregonia	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	109.9	107.5	103.2	100.5	85.9	101.2

The variation in the general lumbar index for Oregonia skeletons is very small, the maximum index being 103.4, the minimum 98. As in the North-west Indians

the special index of the first, second, third and fourth vertebræ are in every single instance 100 or above, except in two cases where the index of the fourth vertebra is 96. In the sums of the measurements of the anterior and posterior depths there is remarkable uniformity, the average being 144 mm. for the sum of the anterior and 145 mm. for the sum of the posterior measurements; the range is from 137 mm. to 150 mm., and from 138 mm. to 152 mm. for the sums of the anterior and posterior measurements respectively.

2. FORT ANCIENT. TABLE X. TEN MALES, SIX FEMALES.

Fort Ancient	MEAN SPECIAL INDEX.					MEAN GENERA INDEX.
	I	II	III	IV	V	
Males	114.3	111.4	106.5	100.0	89.0	104.0
Females	110.1	106.1	102.5	92.5	83.0	98.7
Both sexes	112.2	108.6	104.5	96.2	86.0	101.3

The Fort Ancient skeletons resemble those of Oregonia in the remarkably small amount of variation in the lumbar measurements. In the males the variation of the lumbo-vertebral index varies from 100.7 to 108.9. The special index of the first, second and third lumbars are all over 100, of the fourth three fall below 100. The averages of the sums of the anterior and posterior measurements, 137 mm., and 143 mm., respectively, are very high and the range of variation is small, the maximum and minimum sums being 130 mm. and 145 mm. for the anterior measurements and 135 mm. and 148 mm.

for the posterior. No general lumbar index among the females exceeds 99.2, while the minimum index is 97.5, a remarkably narrow range of variation. Curiously enough the average of the sums of the anterior measurements in the females, 138 mm., exceeds by a single millimetre the average sum of the anterior measurements of the ten males. The posterior average in the female is 136 mm.; the range of variation being 131 mm. to 148 mm., and 127 mm. to 146 mm., for the anterior and posterior sums respectively.

IV. Peru:

1. ANCON. TABLE XI. ELEVEN MALES, EIGHT FEMALES.

Ancon	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	115.2	110.9	107.2	99.2	85.2	102.9
Females	110.1	104.8	101.8	94.7	81.0	97.9
Both sexes	112.6	107.8	104.5	96.9	83.0	100.4

In this table for the first time the average of the special indices of the 4th vertebra in the males falls considerably below 100. Eight of the indices are exactly 100, one is 92.3, another 96 and the other one 104.1. The averages of the sums of the measurements of the lumbars in this group of skeletons falls below any so far recorded in this paper. This is what might be expected from the fact that the coast tribes of Peru were of very short stature. In fact some of those of the south of Peru may almost be called dwarfs. The average of

the sums of the anterior measurements of the five lumbars in the males is 124 mm., highest 138 mm , lowest 114 mm.; average for the females, 120 mm.; highest 126 mm., lowest 113 mm. The general average of the sums of the posterior depths in the males is 130 mm., highest 140 mm., lowest 119 mm.; females, average 117 mm.; highest 121 mm., lowest 110 mm.

In addition to the nineteen skeletons from Ancon which were examined for the preparation of the above table, there were twelve other skeletons which showed marks of senility to such a degree as to necessitate a separate treatment. In the preceding sections such skeletons have not been sufficiently numerous to deserve special notice, and they have consequently been excluded along with the skeletons of children and partially grown individuals. But it is believed that these nine Ancon skeletons may throw some light on the changes produced by old age on the lumbar curve.

ANCON. TABLE XII. FIVE MALES, SEVEN FEMALES. SENILE CONDITION.

Ancon	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	122.1	115.5	112.5	105.2	90.3	109.4
Females	120.5	122.0	107.5	105.6	87.9	106.1
Both sexes	121.3	118.1	110.0	105.4	89.1	107.7

In the next table the results brought out in tables XI and XII are contrasted.

TABLE XIII.

Ancon		MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
		I	II	III	IV	V	
Males	Normal	115.2	110.9	107.2	99.2	85,2	102.9
	Senile	122.0	115.5	112.5	105.2	90.3	109.4
Females	Normal	110.1	104.8	101.8	94.7	81.0	97.9
	Senile	120.5	112.8	107.5	105.6	87.9	106.1
Both sexes	Normal	112.6	107.8	104.5	96.9	83.0	100.4
	Senile	121.3	118.1	110.	105.4	89.1	107.7

There are several interesting points brought out in this comparative view. Perhaps the most striking one is the amount of difference for the two mean general averages. Whether there is any significance in the fact that this difference is greater in the figures for the females than in the males I am unable to determine.

Another interesting point is that the two sexes are more nearly alike for the fifth lumbar than they are for the first lumbar. That is, the amount of difference in the curve for the normal spine and the senile spine is greater at the upper part of the curve than it is at the lower portion. The increased age shows itself especially plain in the spine on the fifth lumbar, which no longer has a distinct wedge-shape, as is shown by the average index 89 for the senile group, as contrasted with the index 83, for the normal group.

It is interesting to note also the marked decrease of the total length of the lumbar region of the spine in the

senile skeletons. In the males the highest total ot the anterior depths is but 124 mm., the average is 117 mm., and the lowest is 113 mm.

Similar measurements for the females are: maximum 118 mm., average 112 mm., minimum 106 mm. To make more clear the comparison between the normal adult and senile condition of the length of the spine, at any rate as far as the lumbar region is concerned, I give the figures in the following table:

TABLE XIV. HEIGHT OF LUMBAR VERTEBRÆ.

Ancon	MALES.		FEMALES.		BOTH SEXES.	
	NORMAL.	SENILE.	NORMAL.	SENILE.	NORMAL.	SENILE.
Average sum of anterior depths . .	mm. 124	mm. 117	mm. 120	mm. 112	mm. 122	mm. 114
Average sum of posterior depths . . .	130	128	117	119	123	123

2. CUZCO. TABLE XV. THREE MALES, THREE FEMALES.

Cuzco	MEAN SPECIAL INDEX.					MEAN GENERAL INDEX.
	I	II	III	IV	V	
Males	115.7	107.5	107.1	95.0	81.8	103.3
Females	112.2	107.7	104.4	95.4	80.4	99.4
Both sexes	113.9	107.6	105.5	95.2	81.1	100.3

In this table, as in the one for Ancon, it may be noted that the break in the curve in the males is between the fourth and fifth lumbars and not between the third and fourth lumbars as is the case in the North American

skeletons. As the Quichuas of the Cuzco region are taller than the coast Peruvians, we may expect an increase in the anterior and posterior lengths of the lumbar spine. In the males, the average anterior length is 133 mm., posterior, 135 mm. in the females, the anterior length is 121 mm., posterior 119 mm. Averages for both sexes are, anterior and posterior, 127 mm.

SUMMARY.

From the fact that the length of lumbar region of the spine is a fairly reliable factor in computing the height of the skeleton, I have summed up in one table the average of the sums of the anterior measurements of the five lumbar vertebræ for both sexes, and have arranged the table in a serial order beginning with the longest lumbar spine.

TABLE XVI. HEIGHT OF LUMBAR VERTEBRÆ.

ANTERIOR HEIGHT OF TRUE LUMBAR VERTEBRÆ.	MM.
Oregonia, Ohio	144
Fort Ancient, Ohio	138
Cuzco, Peru	131
Chinook, British Columbia	130
Iroquois, New York	129
Songish, British Columbia	129
Kwakiutl, British Columbia	128
Ancon, Peru	122

If this table shows nothing else, it at least explains what is already pretty generally known and that is that the ancient inhabitants of the Ohio Valley were very tall

people and that the coast people of Peru are among, if not the shortest people, on the American continent.

The table further emphasizes the great difference in stature between the coast people and those in the mountain valleys of Peru. This difference extends to every part of the skeleton and I am convinced of the utter worthlessness of any observations on the osteology of the "Peruvians" in which the two races are not sharply separated.

It is now time to gather into one table the results so far obtained:

TABLE XVII.

America	Mean Special Index.					Mean General Index.
	I	II	III	IV	V	
Kwakiutl 7 ♂	117.8	110.1	109.8	99.9	88.7	105.0
Kwakiutl 10 ♀	111.2	106.8	100.8	90.7	84.3	98.1
Songish 7 ♂	115.7	111.6	107.9	96.5	82.5	102.2
Songish 5 ♀	111.3	108.0	102.0	92.0	82.8	99.1
Chinook 1 ♂	116.0	115.2	111.5	103.6	80.0	104.4
Chinook 4 ♀	107.1	103.9	99.8	89.5	85.5	98.7
Iroquois 2 ♂	112.5	108.0	105.6	102.9	94.4	105.0
Iroquois 1 ♀	111.1	108.0	100.0	92.5	74.0	96.8
Oregonia, 7 ♂	109.9	107.5	103.2	100.5	85.9	101.2
Fort Ancient 10 ♂	114.3	111.4	106.5	100.0	89.0	104.0
Fort Ancient 6 ♀	110.1	106.1	102.5	92.5	83.0	98.7
Ancon 11 ♂	115.2	110.9	107.2	99.2	85.2	102.9
Ancon 8 ♀	110.1	104.8	101.8	94.7	81.0	97.9
Cuzco 3 ♂	115.7	107.5	107.1	95.0	81.8	101.3
Cuzco 8 ♀	112.2	107.7	104.4	95.4	80.4	99.4

Arranging this table in another manner so as to bring out more clearly the average or general lumbar vertebræ index of the various American races examined, we have:

TABLE XVIII.

		17 KWAKIUTL.	12 SONGISH.	5 CHINOOK.	3 IROQUOIS.	7 OREGONIA.	16 FORT ANCIENT.	19 ANCON.	6 CUZCO.
Mean Special Index of Lumbar Vertebræ	I	114.5	113.5	111.5	111.1	109.9	112.2	112.6	113.9
	II	108.4	108.8	109.5	108.0	107.5	108.6	107.8	107.6
	III	105.3	104.9	105.6	102.8	103.2	104.5	104.5	105.5
	IV	95.3	94.5	96.5	97.7	100.5	96.2	96.9	95.2
	V	86.5	82.6	82.7	84.2	85.9	86.0	83.0	81.1
Mean General Index.		101.5	100.6	101.5	100.9	101.2	101.3	100.4	100.3

Taking the average index of these eight general indices we have an index of 100.9 for American aborigines. I confess to some astonishment at the result. The lack of variation from 100 is striking and more or less puzzling. One thing should be borne in mind, viz., that although the tribes represented above are widely separated, yet they all are good examples of the better sort of Indians found on this continent at its discovery; all of them were semi-barbarians dwelling in more or less permanent homes and depending chiefly upon agriculture for their food supply, although the North-west Coast people were, to a great extent, hunters and fishers. Perhaps it is not wholly without significance that in those two races which

were most civilized and most fixed in their abode we find the lowest lumbo-vertebral index.

Notwithstanding the remarkable uniformity shown in the above results I am almost persuaded, from what I have seen of the osteological characters of the Brazilian and other east coast tribes of South America, that there we shall find a lumbar curve which will approximate that of the lowest races yet examined.

Accepting Turner's classification of the lumbar index we may make the following grouping of those tribes and races which so far have been examined.

KURTORACHIC, INDEX, 98—		ORTHORACHIC, INDEX, 98–102.		KOILORACHIC, INDEX, 102—	
European, . .	96	American:		Hawaiians, . .	104
		Northwest Coast,		Andamanese, .	104.8
		Iroquois,		Negroes, . .	105.4
		Mounds of Ohio,		Bushmen, . .	106.6
		Peru .	100 9	Tasmanians, .	107.2
				Australians, .	107.8

The following conclusions can, it seems to me, be drawn in regard to the Lumbar Index: (1) In any individual race or tribe, it is an important means of determining sex; (2) It bids fair to become one of the most valuable ethnic tests known in determining the physical superiority or inferiority (so-called) of any tribe or race.

THE FLORA OF COLONIAL DAYS.

BY MISS MARY T. SAUNDERS.

In these days of historical research, it is interesting to look back and see what records the colonists left of the plants growing upon these New England shores, and also what efforts they made to promote the growth of many of the home plants which they brought with them. We think of them as a band of men caring little for the gentler side of life and it is pleasant to see that in many instances they had eyes for the beautiful in Nature and rejoiced in the noble trees, waving grass and lowly wayside flowers, as well as in the abundance of fish and game which would minister to their physical needs. The first record, of which we find mention, was made by Gabriel Archer, a gentleman who accompanied Capt. Gosnold in his voyage to the north part of Virginia, in 1602. He says: "May 15, we had again sight of land, which made ahead, being, as we thought, an island, by reason of a large sound that appeared westward, between it and the main, for coming to the west end thereof we did perceive a large opening; we called it Shoal Hope. Near this Cape we came to anchor in fifteen fathoms, where we took great store of cod fish, for which we altered the name and called it Cape Cod. The captain went ashore and found the ground to be full of pease, strawberries, whortleberries, etc., as then unripe.

May 21. The place (Martha's Vineyard) most pleasant, for the two-and-twentieth we went ashore and found it full of wood, vines, gooseberry bushes, whortleberries, raspberries, eglantines, etc. The fire-wood then by us taken in, was cypress, birch, witch-hazel and beech."

"In June, 1603, Martin Pring, with two small vessels, arrived on the American coast, between the forty-third and forty-fourth degrees of north latitude among a multitude of islands. Following the coast south in search of sassafras, he entered a large sound and, on the north side, built a hut and enclosed it with a barricade, where some of the party kept guard while others collected sassafras in the woods. The natives were treated with kindness and the last of the two vessels departed, well-freighted, on the ninth of August."

We next find a record that Edward Winslow, writing from Plimmouth, Dec. 11, 1621, says: "All the spring-time the earth sendeth forth naturally very good salad herbs; here are grapes, white and red, and very sweet and strong also. Strawberries, gooseberries, raspberries, &c., with plums, black and red, being almost as good as a damson, abundance of roses, white, red and damask. single, but very sweet indeed." Another writer from Plymouth speaks of "the bay which is about four miles over from land to land, compassed about to the very sea with oaks, pines, juniper, sassafras and other sweet wood. The crust of the earth a spit's depth (the depth of a spade), excellent black earth, all wooded with oaks, pines, sassafras, juniper, birch, holly, vines, some ash, walnut."

Following in chronological order, we find that the next record is the account of "A Voyage into New England, begun in 1623 and ended in 1624, performed by Christopher Levet. . . . The first place I set my foot upon in New England was the Isle of Shoals, being

islands in the sea about two leagues from the main. Upon these islands, I neither could see one good timber tree, nor so much good ground as to make a garden."[1] From here he journeyed and settled at York, where he says: "I have obtained a place of habitation in New England where I have built a house and fortified it in a reasonable good fashion, strong enough against such enemies as are these savage people. And to say something of the country," and here is a bit of sarcasm, "I will not do therein as some have done to my knowledge, speak more than is true: I will not tell you that you may smell the cornfields before you see the land, neither must men think corn doth grow naturally (or on trees) nor will the deer come when they are called, or stand still and look upon a man until he shoot him, not knowing a man from a beast; nor the fish leap into the kettle nor on the dry land, neither are they so plentiful that you may dip them up in baskets, nor take cod in nets to make a voyage, which is no truer than that the fowls will present themselves to you with spits through them. But certainly there is fowl, deer and fish enough for taking if men be diligent; there be also vines, plum trees, strawberries, gooseberries and rasps, walnuts, chestnuts and small nuts, of each great plenty; there is also great store of parsley

[1] Celia Thaxter seems to have demonstrated that this was an error. She made a very famous garden there. Perhaps the soil of it was carried to the island from the main land.

The early records are filled with orders for the protection and disposal of the timber growing on these shore islands. They do not indicate the nature of the wood, but it seems to have been valued for ship-building. The "Miseries" were "Moulton's Miseries," and got the name from Robert Moulton, the chief shipwright here in 1629. Probably when Governor Endecott asked for and obtained a grant of Catta Island (now Lowell Island) in 1655, he was moved by a consideration of the value of its growing timber. When the larger islands became bare and denuded of shade, as we see them, has not been stated, but Catta Island was a wooded island in 1735, and was stripped of its trees by the British sloop-of-war Merlin, while enforcing the Boston Port Bill on the night of January 6–7, 1776, probably to secure a better view into Salem and Marblehead harbors. —EDITOR.

and divers other wholesome herbs, both for profit and pleasure, with great store of sassafras, sarsaparilla and anise seeds. Thus have I related unto you what I have seen and do know may be had in these parts of New England where I have been, yet was I never at Massachusetts, which is counted the paradise of New England, nor at Cape Ann, but I fear there hath been too fair a gloss set on Cape Ann."

In 1629, Rev. Francis Higginson came to Salem in the ship Talbot, and from the relation of his voyage a few passages can be quoted, showing how deeply he was impressed by the appearance of the country.

"June 24. This day we had all a clear and comfortable sight of America and of Cape Sable that was over against us seven or eight leagues northward. Here we saw yellow gilliflowers on the sea." These were probably the Alexanders seen by Gosnold on Elizabeth island, *Thaspium aureum.*

"Friday, 26th. A foggy morning, but after clear and wind calm. The sea was abundantly stored with rock-weed and yellow flowers like gilliflowers. By noon we were within three leagues of Cape Ann, and as we sailed along the coasts we saw every hill and dale and every island full of gay woods and high trees. The nearer we came to the shore the more flowers in abundance, sometimes scattered abroad, sometimes joined in sheets nine or ten yards long, which we supposed to be brought from the low meadows by the tide. Now what with fine woods and green trees by land and yellow flowers painting the sea, made us all desirous to see our new paradise of New England, where we saw such forerunning signals of fertility afar off.

"Saturday, 27th. We had a westerly wind which brought us between five and six o'clock to a fine and

sweet harbor, seven miles from the head-point of Cape Ann. There was an island (Ten pound island) whither four of our men with a boat went and brought back again ripe strawberries and gooseberries and sweet, single roses."

"The sweet briar and gooseberries are still found on the island and before it was cleared up, strawberries were found there," says Dr. Charles Pickering.

"Monday, 29th. We passed the curious and difficult entrance into the large and spacious harbor of Naimkecke, and as we passed along, it was wonderful to behold so many islands replenished with thick wood and high trees and many fair, green pastures." After passing the winter of 1629-30 at Salem, Mr. Higginson writes: "The fertility of the soil is to be admired at, as appeareth in the abundance of grass that groweth everywhere, both very thick, very long and very high, in divers places. But it groweth very wildly with a great stalk and a broad and ranker blade, because it had never been eaten with cattle, nor mowed with a scythe, and seldom trampled on by foot.

"Our Governor hath store of green pease growing in his garden, as good as ever I eat in England. This country aboundeth naturally with store of roots of great variety and good to eat. Our turnips, parsnips and carrots are here both bigger and sweeter than is ordinarily to be found in England. Here are also store of pumpions, cowcumbers, and other things of that nature which I know not; also divers excellent pot-herbs, growing among the grasse, as strawberrie leaves in all places of the country and plenty of strawberries in their time, and penny royal, winter savory, sorrell, brooklime (*Veronica Americana*), liverwort, carvell and water cresses. Also leeks and onions are ordinary and divers physical herbs.

Here are also abundance of other sweet herbs delightful to the smell, whose names we know not, and plenty of single damask roses, very sweet, and two kinds of herbs that bear two kinds of flowers, very sweet, which they say are as good to make cordage or cloth as any hemp or flax we have. Excellent vines are here up and down in the woods. Our Governor hath already planted a vineyard, with great hope of increase. Also mulberries, plums, raspberries, currants, chestnuts, filberts, walnuts, small nuts, hurtleberries and haws of white thorn near as good as our cherries in England; they grow in plenty here. For wood, there is no better in the world, I think, here being four sorts of oak, differing both in the leaf, timber and color, all excellent good. There is also good ash, elm, willow, birch, beech, sassafras, juniper, cypress, cedar, spruce, pines and fir that will yield abundance of turpentine, pitch, tar, masts, and other materials for building both of ships and houses. Also here are sumach trees that are good for dyeing and tanning of leather; likewise such trees yield a precious gum called white benjamin that they say is excellent for perfumes. Also here be divers roots and berries wherewith the Indians dye excellent holding colors that no rain or washing can alter." The carvell of which Mr. Higginson speaks is chervil or sweet cicely (*Osmorrhiza longistylis*), and was found by Dr. Charles Pickering in a rocky, precipitous place at "Paradise," North Salem, possibly the spot where it was seen by Mr. Higginson. The mulberry, flowering raspberry (*Rubus odoratus*), still flourishes in "The Great Pastures."

In this same year, 1629, William Wood arrived in New England, but he lived principally in the Plymouth colony. He writes of the trees: "An ash different from the ash of England, being brittle and good for little, ever trem-

bling asps, the red oake, the white oake, and a third kind, the blacke. The diar's shumach, the cedar tree, not very high and its wood more desired for ornament than substance, being of color red and white, smelling as sweet as juniper—the white cedar, the mournefull cypres tree," as distinguished from the cedar with red wood, the American elm, which he calls the "broad spread elme whose concave harbours waspes." In planted gardens and in woods, "sweet marjoram, sorell, perennial yarrow, hempe and flaxe, some planted by the English, with rapes, besides turnips, parsnips, carrots, radishes, muskmillions, cucumbers, onyons, also good crops of rye, oates and barley." He mentions the rattlesnake root (*Nabalus alba*) as the "root called snake-weed" an antidote to the bite of the rattlesnake of which Mr. Higginson says, "to bite on within a quarter of an houre by the partie stinged," —the snake weed was always carried about by Governor Winthrop in summer time. Wood also speaks of the "treackle berries" and he says, "There is likewise strawberries in abundance, very large ones, some being two inches about. One may gather half a bushel in a forenoon. Vines afford great store of grapes, which are very big both for the grape and cluster: sweet and good. There is likewise a smaller kind of grape which groweth on the islands (that is of Massachusetts Bay) which is sooner ripe and more delectable, so there is no known reason why as good wine may not be made in these parts as well as Bordeaux in France, being under the same degree." The choke cherry, "red cherries which grow on clusters like grapes, are much smaller than our English cherry and so furre the mouth, that the tongue will cleave to the roof." Roger Williams wrote of the strawberry. "This berry is the wonder of all the fruits growing naturally in these parts. It is of itself excellent, so

that one of the chiefest doctors of England was wont to say, 'God could have made, but God never did make a better berry.' In some parts where natives have planted, I have many times seen as many as would fill a good ship within a few miles compass." In September, 1629, Master Graves sent a letter to England in which he wrote at length of the fertility of the soil. "The grass and weeds," he said, "grow up to a man's face in the lowlands and by fresh rivers abundance of grass and large meadows, without any tree or shrub to hinder the scythe." He speaks of the grapes,—"some I have seen four inches about."

William Bradford, Governor of Plymouth Colony, wrote "A Descriptive and Historical Account of New England" in verse, which has much of interest in this connection—

"Almost ten years we lived here alone—
In other places there were few or none;
For Salem was the next of any fame
That began to augment New England's name.
But after, multitudes began to flow
More than well knew themselves where to bestow.
Boston then began her roots to spread,
And quickly soon she grew to be the head
Not only of the Massachusetts Bay
But all trade and commerce fell in her way.
And truly it was admirable to know
How greatly all things here began to grow,

[2] Governor Winthrop arrived at Salem in June of the next year, 1630, and this is the entry in his Journal:—"passed through the narrow strait between Baker's Isle and Little Isle, and came to an anchor a little within the islands. After Mr. Peirce came aboard us and returned to fetch Mr. Endecott, who came to us about two of the clock and with him Mr. Skelton and Capt. Levett. We that were of the assistants and some other gentlemen with some of the women and our Captain returned with them to Nahumkeck where we supped with a good venison pasty and good beer, and at night we returned to our ship. But some of the women stayed behind. In the meantime most of our people went on shore upon the land of Cape Ann which lay very near us and gathered store of fine strawberries." Wild strawberries still abound on the upland along West's Beach. —EDITOR.

New plantations were in each place begun
And with inhabitants were filled soon.
All sorts of grain which our own land doth yield
Was hither brought and sown in every field,
As wheat and rye, barley, oats, beans and pease
Here all thrive and they profit for their raise.
All sorts of roots and herbs in gardens grow,
Parsnips, carrots, turnips or what you'll sow.
Onions, melons, cucumbers, radishes,
Skirets, beets, coleworts and fair cabbages.
Here grow fine flowers, many, and 'mongst those
The fair, white lily and sweet fragrant rose.
Many good wholesome berries here you'll find
Fit for man's use almost of every kind.
Pears, apples, cherries, plumbs, quinces and peach
Are now no dainties, you may have of each,
Nuts and grapes of several sorts are here
If you will take the pains them to seek for."

It appears somewhat singular and only proves that the colonists knew nothing of the severity of the climate, that they should have thought seriously of planting vineyards in this region. Vine planters are mentioned in a list that the company were to provide to send to New England.[3] In 1634, the yearly rent of Governor's Island in Boston Harbor was a hogshead of wine. That island had been granted to Governor Winthrop on condition that he should plant a vineyard or orchard there. Thomas Leckford spent four years in the country and wrote an article, "Plaine dealing or Newes from New England." He speaks of the land, cattle and grain and mentions one fact which other writers omitted that "the Pease have no wormes at all." July, 1638, there arrived at Boston, John Josselyn, son of Sir Thomas Josselyn of Kent, and brother of Henry Josselyn, Esq., of Black Point, in

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[3] Vine planters were to be sent over Feb. 1628. According to Cradock's letter to Endecott, April 1629, they were to have been Frenchmen but such could not be found.—Mass. Colony Records, vol. I, p. 24 and p. 390; Suffolk Deeds, *Liber* I, *Folio* VI.—EDITOR.

Scarborough, Maine. After staying a short time at Boston, he went to his brother's home in Maine, where he remained until October of the following year. In 1663, he again visited the country and stayed eight years. The results of his travels, observations, etc., are recorded in two volumes, one entitled "New England's Rarities discovered in birds, beasts, fishes, serpents, and plants of that Country," and published at London in 1672; the other, "An Account of two voyages to New England." The former book was issued, with full and valuable annotations, by Prof. Edward Tuckerman in 1865, and from this we quote largely. He says, "Josselyn was, it appears, a man of polite reading." His curiosity in picking up "excellent medicines," points to an acquaintance with physic, of his practising which there occur several instances. Nor is he by any means uninterested in prescriptions for the kitchen as, for instance, when he gives an elaborate recipe for cooking eels and also one for a compound liquor "that exceeds passada, the nectar of the country," which is made, he tells us, of "Syder, Maligo Raisons, Milk, and Syrup of Clove Gilliflowers." But his curiosity in Natural History and especially Botany is his chief merit and this now gives almost all the value that is left to his books. William Wood, the author of "New England's Prospects," was a better observer generally than Josselyn, but the latter makes up for his shortcomings by the particularity of his botanical information. But we will return to the "Rarities," and see what record Mr. Josselyn has left of the plants of the country. He has divided them into five groups, viz:

1. Such Plants as are common with us in England.
2. Such Plants as are Proper to the country.

3. Such Plants as are Proper to the country and have no name.

4. Such Plants as have sprung up since the English planted and kept cattle in New England.

5. Such Garden Herbs amongst us as do thrive there and such as do not.

In the first group some of the most familiar are the following: Cat's-tail, Wild Sorrel, Blew Flower de luce, Yellow bastard Daffadil, it flowereth in May, the green leaves are spotted with black spots. Water-cresses, Red Lillies, One Blade (*Smilacina bifolia*) Lilly Convallie with the yellow flowers, Small water archer (arrow head), Autumn Bell Flower (Closed Gentian). Glass-wort grows abundantly in salt marshes. Upright Peniroyal, Catmint, Water Lily with yellow flowers, the Indians eat the roots, the Moose Deer feed upon them, at which time the Indians kill them, when their heads are under water. Dragons (*Arum*) — they come up in June. Violets of three kinds, Solomon's Seal, Doves Foot, and Herb Robert, Yarrow, with the white flower, Columbines of a flesh color, growing upon rocks, Ferns and Brakes, Dew Grass (*Drosera*), Lime Tree, both kinds, Maple, Elm, Fuss Balls, very large. Noble Liverwort, Blood Root, Black-Berry, Dew Berry, Rasp Berry, Hawthorn, Toadflax, there is Oak of three kinds, Juniper, very dwarfish and shrubby, growing for the most part by the seaside. Willow, Spurge Laurel, called the Poyson Berry, it kills the English cattle if they chance to feed upon it, especially calves. Gaul or noble mirtle (*Myrica gale*), Alder, Hazel, Walnut, Chestnuts, very sweet in taste, and may be, as they usually are, eaten raw; the Indians sell them to the English for twelve pence the bushel. Wild Purcelane, it is eaten as a pot-herb and esteemed by some

as little inferior to asparagus. Woodwax, wherewith they dye many pretty colors.

NOTE.—There is a tradition that it was introduced here by Gov. Endecott, which may have been some forty years before Josselyn finished his herborizing—enough to account for its naturalization then. It was long confined to Salem. Dr. Cutler says "pastures between New Mills and Salem." Woad seed is set down in a memorandum of the Governor and Company of Massachusetts Bay before February, 1628, to be sent to New England. Gov. Endecott is also responsible for importing another plant to his Danvers home, for we find in Hanson's History of Danvers this note, after referring to Gov. Endecott's land: "If tradition be correct, he introduced for medicinal purposes, as well as by way of ornament to his garden, the White-weed, or *Chrysanthemum leucanthemum* of the botanist, which has since become so detrimental to the hayfields of our farmers in some parts of the State."

"Of such Plants as are proper to the country. Indian Wheat, of which there are three sorts, yellow, red and blew. Mountain Lillies, bearing many yellow flowers. Hollow-leaved Lavendar is a plant that grows in salt marshes, overgrown with moss, with one straight stalk about the bigness of an Oatstraw, better than a cubit high; upon the top standeth one fantastical Flower, the Leaves grow close from the root in shape like a Tankard, hollow, tough and always full of Water, the Root is made up of many small strings, growing only in the Moss and not in the Earth, the whole Plant comes to its perfection in August, and then it has Leaves, Stalks and Flowers, as red as blood, excepting the Flower, which hath some yellow admixt. I wonder where the knowledge of this Plant hath slept all this while, *i. e.*, above Forty Years. Tree Primrose, Maiden Hair, ordinarily half a yard in height, Pirola of two kinds, Indian Beans, Squashes, but more truly Squonter-squashes, a kind of Mellon or rather Gourd, Pompiones and Water Mellons, too, they have in good store. New England Daysie or Primrose, flowers in

May and grows amongst moss upon hilly grounds or rocks that are shady. Wild Damask Roses, single, but very large and sweet. Sweet Fern, Sarsaparilla, Bill Berries, two kinds, Black and sky colored, which is more frequent. Sumach, our English cattle devour it most abominably. The cherry trees yield great store of cherries which grow in clusters like grapes. They be much smaller than our English cherry; nothing near so good, if they be not fully ripe; English ordering may bring them to an English cherry, but they are as wild as the Indians. Board Pine (*P. strobus*) is a very large tree. Pitch Pine, its wood cloven in two little slices something thin, the only candles used by the New England natives, and Higginson found them adopted by the first colonists." The Board Pine, the loftiest tree of New England, was seen in 1605 by Capt. George Weymouth on the Kennebec, and hence the name Weymouth Pine given in England to the imported deals. Wood refers to these Pines, the White Pines, when he speaks "of these stately, high-growne trees, ten miles together, close by the river side." "The Larch Tree, which is the only Tree of all the Pines that sheds his Leaves before Winter, the others remaining Green all the Year. Hemlock Tree, the bark of this serves to dye Tawny. Cran-Berry, or Bear-Berry, because Bears use much to feed upon them, is a small trayling Plant that grows in Salt marshes that are overgrown with moss. The Indians and English use them much, boyling them with Sugar for Sauce to eat with their meat. Pirola, or Wintergreen, that kind which grows with us in England, is common in New England, but there is another plant which I judge to be a kind of Pirola and proper to this country, a very beautiful Plant. The Ground of the Leaf is a Sap Green, embroydered (as it were) with many pale yellow Ribs, the whole Plant in shape is like

Sempervivum, but far less, being not above a handful high, with one slender stalk adorned with small, pale, yellow Flowers, like the other Pirola. It groweth not everywhere, but in some certain, small spots, overgrown with moss, close by swamps and shady, they are green both Summer and Winter." Another plant is illustrated and described in the following language: "This Plant the Humming Bird feedeth upon, it groweth likewise in wet grounds, and is not at its full growth till July, and then it is two cubits high and better, the leaves are thin and of a pale green colour, some of them as big as a Nettle leaf, it spreads into many Branches, knotty at the setting on and of a purple colour, and garnished on the top with many hollow, dangling Flowers of a bright, yellow colour, speckled with a deeper yellow as it were shadowed; the Stalkes are as hollow as a Kix, and so are the Roots, which are transparent, very tender and full of a yellowish juice." The list of plants in the fourth group is short and we will mention only a few; they are the plants which have sprung up since the English planted and kept cattle. "Couch Grass, Shepherd's Purse, Dandelion, Mallowes, Plantain, which the Indians call English Man's Foot, as though produced by their treading, Knot Grass, Chickweed. I have done now with such plants as grow wild in the country. I shall now in the Fifth place give you to understand what English herbs we have growing in our Gardens that prosper there as well as in their proper soil, and of such as will not grow there at all. Cabbage grows there exceeding well. Lettice, Parsley, Burnet, Tansie, Sage, Carrots, Parsnips of a prodigious size," other Vegetables and grains. "Spearmint. Rew will hardly grow. Southern Wood is no Plant for the country, nor Rosemary, nor Bayes, Lavendar Cotton, but Lavendar is not for the cli-

mate. Gilly Flower will continue two years. Fennel must be taken up and kept in a warm cellar all winter. Houseleek prospereth notably. Hollyhock, Sparagus, Satin,—'we call this herb in Norfolke Sattin'—says Gerard, and among our women it is called Honestie, Garden Sorrel and Sweet Bryer or Eglantine. English Roses very pleasantly, Celandine."

There are very many plants which we have omitted, but the principal familiar ones have been given. We can see that much progress had been made and that the gardens were well stocked. When Josselyn made his first visit in 1638-9, he was treated with "half a score very fair pippins" from the Governor's Island in Boston Harbor, though there was then he says, "not one apple tree, nor pear planted yet in no part of the country but upon that island."[4] But he has a much better account to give in 1671. "The quinces, cherries, damsons, set the dames a work. Marmalad and preserved damsons is to be met with in every house. Our fruit trees prosper abundantly. Apple trees, pear trees, quince trees, cherry trees, plum trees, barberry trees. The countrey is replenished with fair and large orchards." Here end our quotations from the "Rarities" and with one more item, this paper must be brought to a close. "Sebastian Raslis, a missionary from the Society of Jesuits to the Indians in North America, 1689, in speaking of the method of illuminating his chapel, observes that he had found an excellent substitute for wax, by boiling the berries of a kind of laurel in winter and skimming off the thick, oily substance which rose to the top. Twenty-four pounds of this beautiful green wax, and an equal amount of tallow will make one hundred wax candles of a foot long."

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[4] Probably Josselyn was mistaken. The Governor Endecott pear-tree is thought to have been planted where it now stands, in 1630.—Memoir of John Endecott, by Chas. M. Endicott, p. 23, note.—EDITOR.

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OBJECTS FROM PRE-HISTORIC GRAVES, BEVERLY, MASS.

OBJECTS FROM PRE-HISTORIC GRAVES, BEVERLY, MASS.

PRE-HISTORIC RELICS FROM BEVERLY.

(WITH TWO PLATES.)

CONTRIBUTED BY JOHN ROBINSON.

ON July 21, 1871, a very interesting collection of pre-historic objects was obtained by the Peabody Academy of Science from three graves, accidentally discovered on Lovett street, Beverly, by workmen engaged in digging a trench. Some account of these objects will be found on page 125 of the Bulletin of the Essex Institute for 1871, Vol. III, as announced by Mr. F. W. Putnam at an Institute field meeting held at Ship Rock, Peabody, Aug. 2, 1871. It was intended to give a fuller description of this collection, with illustrations, in the "American Naturalist" magazine, but this was never done. Professor Putnam also intended to contribute, to the memoirs of the Peabody Academy, an article on the pre-historic graves in Essex County; but, later, this plan was relinquished. For this last purpose, however, two excellent lithographic plates were prepared by Mr. G. M. White, and printed. It is now thought well to use these plates for the Institute Bulletin, and they are introduced here as supplementary to the article of 1871, Vol. III, pp. 123–5, above mentioned.

The plates cover the more interesting objects found in the three graves at Beverly and may be described as follows:—

Plate I.

Fig. 1. Pipe, peridotite; very probably made of the rock, commonly called soapstone, from the Andover outcrop.

Fig. 2. Knife blade of Marblehead felsite.

Fig. 3. Spear-head of Marblehead felsite.

Fig. 4. Celt or skin dresser of diorite.

Plate II.

Fig. 1. Slate stone marked as shown.

Fig. 2. Slate tablet, very probably made of the Bradford rock.

Fig. 3. Slate tablet, as last.

Fig. 4. Tablet of porphyritic dyke rock. It shows indication of the beginning of a hole at the smaller end as in figure 2.

All of the objects are drawn actual size. In addition to the objects figured, there are in this collection from the Beverly graves, another tablet, similar to fig. 2, Plate II, but of a lighter colored slate; a porphyritic dyke rock pebble, with indentations on the edge; two flat pieces of sandstone, evidently used for rubbing or sharpening implements; a flat slate stone and two pebbles showing traces of ochre upon them; and several thin pieces of muscovite mica of the Andover form of this mineral. The identification of the rock materials has been made by Mr. Sears. There is no reason to suppose that these implements originated outside of Essex County; for, in each case, a rock of precisely the same character as the object is found within the limits of the county.

There are, in the county collections of the Peabody Academy, a large number of interesting objects obtained from pre-historic graves, or graves of the people of the

pre-historic race which occupied this region, although from the finding of European beads and copper trinkets in connection with aboriginal stone implements, these latter burials must have been made after the year 1500, when Europeans had visited our shores. In the case of the Beverly graves from which the objects figured were obtained, unless the pipes are of European workmanship, or were made with tools obtained from the early voyagers, the age may be placed at more than 350 years. If, however, the pipes were made by Europeans or with tools obtained from them, then 270 to 350 years would be a safer estimate for the age of the objects found; they undoubtedly antedate the permanent settlement of the region in 1626.

PEABODY ACADEMY OF SCIENCE,
Jan. 19, 1897.

NOTE TO ARTICLE OF REV. WM. P. ALCOTT

Since pages 92–94 were in print I have other items as to the history of this Ilex from Mrs. Horner. The bush originally stood by the roadside in the edge of No. Andover. It was transplanted by Mr. P. B. Folansbee to his nursery at Haggett's Pond, and a rooting from it is growing at the Arnold Arboretum. Professor Gray considered this plant simply a freak, like the white huckleberry, etc.

In his "November Chronicle," *Atlantic Monthly*, Nov. 1888, Mr. Bradford Torrey mentions finding—perhaps in a wider range of conditions—73 species blooming during Nov. 1887.

BOTANICAL NOTES.

BY REV. WM. P. ALCOTT, BOXFORD.

The writer's duties have called him to drive in different directions nearly every day of November, 1896. He has noted the roadside flowers seen on these rides, together with such as he could find about his own premises. Persons having opportunity for systematic search may have found many more during such a favorable month, and I shall be happy if my own list may serve to call forth longer catalogues. Certain plants which I have not found must surely have been observed, while some mentioned are evidently exceptional cases. Quite a list of Cryptogams might be added and possibly a few belated grasses.

The vigor and beauty of *Aster undulatus*, even so late as the 18th, was very interesting. It will be noted that fifteen of these brave twenty-eight were Compositæ.

Flowering plants of the following were abundant:

Capsella bursa-pastoris, L.
Lepidium Virginicum, L.
Brassica campestris, L.
Stellaria media, L.
Malva rotundifolia, L.
Trifolium pratense, L.
Hamamelis Virginica, L.
Aster undulatus, L.
Aster miser, L.
Erigeron Canadense, L.
Solidago cæsia, L.
Solidago altissima, L.

Solidago memoralis, Ait.
Achillea millefolium, L.
Gnaphalium polycephalum, Mchx.
Leontodon autumnale, L.
Taraxacum dens-leonis, Desf.
Lobelia inflata, L.

Two or three specimens were seen of these :—

Solidago bicolor, L.
Maruta cotula, D. C.
Erecthites hieracifolia, Raf.
Gentiana crinita, Frœl.

Of six only single flowering specimens were observed :

Ranunculus acris, L.
Sinapis nigra, L.
Viola sagittata, L.
Potentilla argentea, L.
Aster dumosus, L.
Aster longifolius, Lam.

Early this last summer Mrs. C. N. S. Horner called my attention to a strange plant found somewhere in Georgetown, which proved to be an emigrant from Western Europe, *Hieracium aurantiacum*, var. *bicolor*. Later in the season, during a carriage ride, this plant was seen to be very abundant at a place near East Templeton, Worcester County, and also in Florida, Berkshire County, along the main road over Hoosac Mountain. It thus grows "in high pastures" here, as across the Atlantic. Should it flourish at lower altitudes it might prove another of those beautiful but most troublesome weeds which the Old World has so often sent us. If memory is correct, I have seen this plant on the high ground of Mr. T. C. Thurlow's Nursery, at West Newbury.

Other interesting "finds," by that most observing bota-

nist, Mrs. Horner, have been *Salvia virgata* and *Trifolium tomentosum*, L., both of Southern Europe. The latter was found ten years ago and from the place of its discovery in Georgetown, is evidently to be added to the list of "Woolen Mill Plants." I am not aware that it has been collected there since. The *Salvia* appeared this summer, or last, among the seedling flowers of a garden.

A small-flowered pink, *Silene gallica*, var. *quinquevulnera*, has bloomed for me two years, coming with "wild garden" seed, probably imported from France. Botanists who know our native weeds from strange ones may often get rare things in this way.

What one might call persistent local attachment is remarkably manifested in some plants. Crocuses and Star-of-Bethlehem (*Ornithogalum*) blossom every year in the dense sward near my house, where they must have been planted twenty-five years ago, perhaps much more, having never in that time been cultivated. Probably some readers can far overmatch these instances. *Polygonum bistorta*, L., also grows, and often flowers, in the same grass, in spite of having been mown close, once or twice a summer for many years. No doubt it is a relic of some ancient garden.

In August a white-flowered form of *Linaria Canadensis*, Spreng., was somewhat abundant near Milwood P. O., Rowley. Years ago specimens of "white-fruited" black alder, *Ilex verticillata*, Gray, were given to the Boxford Natural History Society, from a bush on the land of a Mrs. Cole, of West Boxford. The berries were rather of a yellow color. One specimen of *Houstonia purpurea*, L., var. *longifolia*, with white flowers, was also brought to our Society from near the center of the town, sown perhaps with grass seed, which so often brings into our soil transient and extra-limital specimens.

For a note appended to the above, see p. 91.

ON A NEW GENUS AND TWO NEW SPECIES OF MACRUROUS CRUSTACEA.[1]

BY J. S. KINGSLEY.

I owe to Professor Hermon C. Bumpus, of Brown University, the privilege of examining a small shrimp which he obtained from the Island of Naushon, one of the Elizabeth Islands, on the southern coast of Massachusetts. Under ordinary circumstances the publication of isolated descriptions is to be deplored, but in this case the procedure seems to have some justification. In the first place the whole Vineyard Sound region has been so thoroughly explored by the various parties of the U. S. Fish Commission and by the members of the Marine Biological Laboratory at Woods Holl, that novelties among the Decapod Crustacea are extremely rare. Again, the form in question is unique in several of its features, combining as it does the characters of several other genera or even of so-called families.

The specimen, which is the basis of the following description, was found July 13, 1893, in the sand of the small channels — the so-called gutters — of the island.

Genus Naushonia. Body somewhat depressed; mandibles stout, incurved, the cutting edge excavate anteriorly, the edge itself serrate; a two-jointed palpus present.

[1] Contributions from the Biological Laboratories of Tufts College, under the direction of J. S. Kingsley, No. XVI.

First pair of feet larger than the second, the first pair being sub-chelate, the second non-chelate, and with simple carpus. Antennulæ biflagellate, the inner flagellum about half the length of the outer. Antennæ long; antennal scale small, not reaching to the external spine.

This genus resembles the Crangoninæ in the larger first pair of pereiopoda; in the sub-chelate character of the anterior hand, and the non-annulate carpus of the second pair of pereiopoda. It differs, however, from this sub-family, and from all the Crangonidæ as limited by Dana, in the excavate mandible and in the possession of a mandibular palpus. The cutting edge of the mandible recalls somewhat that of the Atyidæ, but the palpus is not present in that family. Mandibular characters also exclude it from all known Palæmonidæ. Subsequent investigations may show that it will be necessary to erect a new 'family' for its reception.

Naushonia crangonoides n. sp. Carapax somewhat cylindrical, depressed in front, the rostral region being down curved. The rostrum flattened, tip broadly triangular, extending forward slightly beyond the eyes. Supra-orbital and antennal spines present; branchiostegal, hepatic and pterygostomian spines lacking. Cervical groove well marked in the middle but not reaching the antero-lateral margin of the carapax. A well-marked impressed line extends from the antero-external angle on either side to the posterior margin of the carapax. With these exceptions the carapax is smooth and is without pubescence. The abdomen is about a third longer than the carapax; is smooth and without carinæ, spines, etc. The telson is a third longer than broad, its tip regularly and broadly rounded, with a spine at each external angle. The eyes are on short peduncles, not visible from above, and with a minute pigment spot. The antennulæ are

biflagellate, the flagella short, the inner ramus being about half the length of the outer. The antennæ are provided with a small basal scale, the external spine of which reaches to the middle of the last joint of the peduncle, while the laminate portion of the scale falls short of the external spine. The external maxillipeds are pediform, elongate and furnished with extremely long hairs. The mandibular palpus bears simple hairs on its inner, and stiff bristles on its outer margin. The pereiopoda are provided with small exopodites. The first pair (only the left present in the specimen) are much the larger, and recall strongly the corresponding appendage in the Crangonids, but the occludent margin is more oblique than in most of the genera of that group. The meros is about twice as long as the ischium, and both these joints have the external margin acute. The short carpus is approximately an equilateral triangle in outline. The hand is flattened, the propodus being twice as long as broad, and externally with an acute edge. A long acute 'thumb' directed obliquely forward, at about the middle of the inner margin of the propodus, limits the occludent margin of the palm. This margin is acute and is provided with one large and several smaller teeth, the distribution of which is shown in the figure. The dactylus is bent, proximally, at a right angle, the distal portion being regularly arcuate and the tip acute. Its margins are sharp and the outer one is provided with a fringe of long hairs. The second pair of feet are the shortest, the carpus is simple, without annulations, and the dactylus is flattened and covered with a pubescence of long hairs. The remaining pereiopoda are slender, pediform and terminated by acute, slightly curved dactyli. The total length from the tip of the rostrum to the end of the telson is 26 mm.

Caradina pasadenæ n. sp. Carapax smooth, ecarinate above, rostrum long, three-fourths the length of the carapax, and exceeding by a third of its length the antennular peduncle. It is smooth above, its apex minutely bifid, and occasionally a small tooth beneath at about the level of the extremity of the antennular peduncle. Pterygostomian spine present, rather obtuse; external angle of the orbit spiniform. Antennula with external spiniform scale on the outer margin of the basal joint, reaching slightly in advance of the extremity of the joint, a small spine on the inner margin of the joint. Antennal flagella subequal in length, the length about equal to that of the carapax without the rostrum. Antennal scale about four times as long as broad, extending slightly beyond the antennular peduncle; its external margin straight, its apex obliquely rounded; antennal flagellum about two-thirds the length of the body. External maxillipeds pediform, the ischium strongly arcuate; the terminal joints partly fused and armed with two rows of spines; exopodite slender, filiform, joints obsolete. First pair of pereiopoda short, rather stout, the meros about equal to the propodus in length; hand of regular Atyid character, the fingers excavate and furnished with pencils of hairs. Second pair of pereiopoda about twice the length of first, the carpus simple, slightly obconical, and longer than any other joint; fingers excavate and pencilled. Remaining pereiopoda elongate, pediform, with moderate, slightly curved dactyli, spinulose beneath. Telson with straight, converging sides, its apex truncate and spinulose. Total length from tip of rostrum to end of caudal pleopoda 32 to 39 mm.

This species, which was sent me by Professor A. J. McClatchie of Throop University, is stated by him to be common in the streams about Pasadena, California. This species differs from *C. multidentata*, *serrata*, *acuminata*,

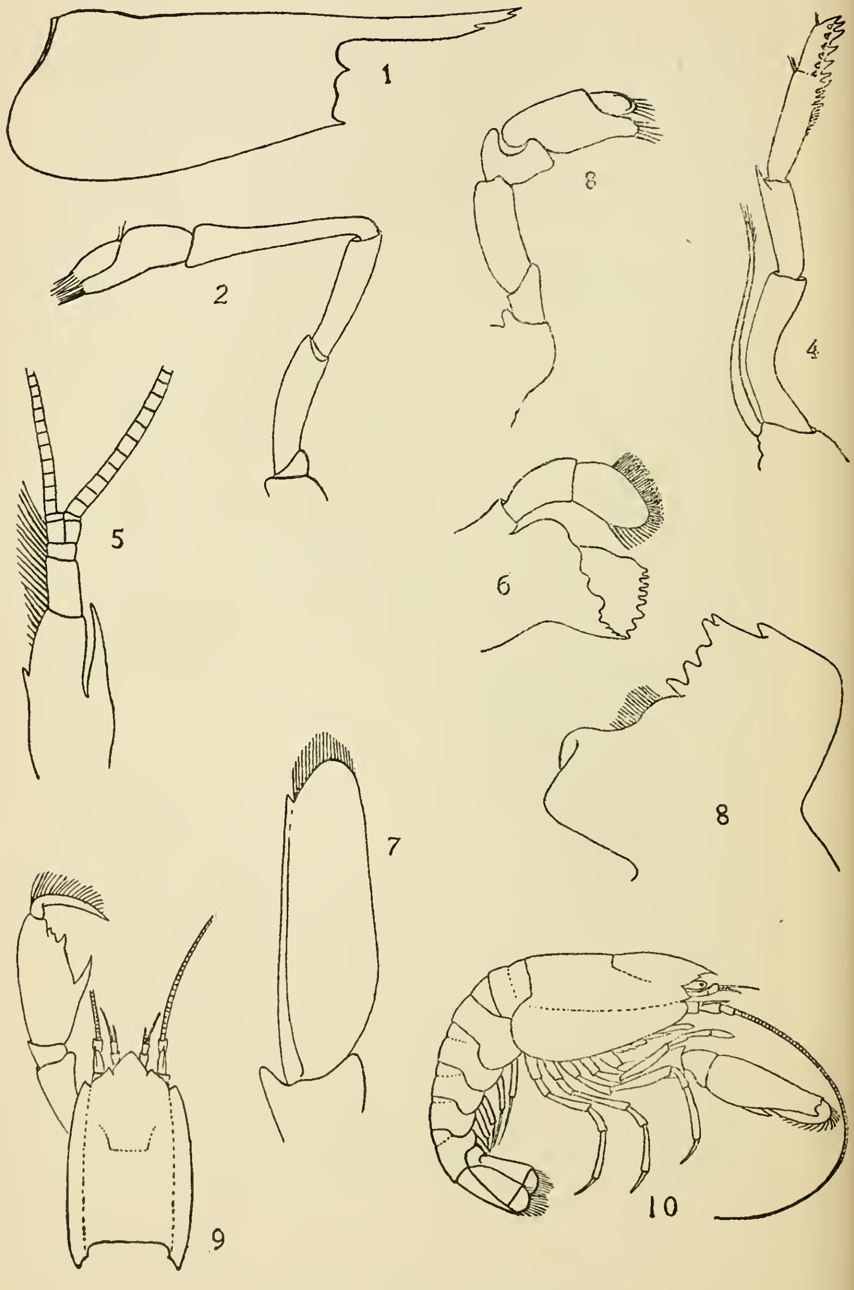
brevirostris, *exilirostris* and *typus* in its elongate rostrum. From *C. grandirostris* and *leucosticta* it differs in the lack of teeth upon the upper margin of the rostrum; from *C. americana* in the almost total lack of teeth on the lower surface of the rostrum, while *C. denticulata* is thrown out by similar characters. *C. tenuirostris* is a species of Virbius.

[Published, March, 1897.]

EXPLANATION OF PLATE III.

Figs. 1–7. *Caradina pasadenæ*. Figs. 8–10. *Naushonia crangonoides*.

Fig. 1. Carapax.
" 2. Second pereiopod.
" 3. First pereiopod.
" 4. External maxilliped.
" 5. Base of antennæ.
" 6. Mandible.
" 7. Antennal scale.
" 8. Mandible.
" 9. Carapax, etc., from above.
" 10. Side view.



KINGSLEY. NEW CRUSTACEA.

THE NASAL ORGANS OF PIPA AMERICANA.[1]

BY IRVING REED BANCROFT.

THE investigations recorded in the following paper were undertaken at the suggestion of Professor Kingsley, who pointed out to me that the nasal structures of the Surinam toad differed considerably from those described by Seydel as occurring in other Batrachia ; and that aside from a short reference by Stewart Lee, no account of the olfactory organ of *Pipa americana* was accessible.

The whole work was done by means of sections and plastic models, the slides being the same as those which formed the basis of Arnold's paper on the cranial nerves. The animals were from 9 to 12 mm. in body length and in their general features were much like the adult. The systematic position of Pipa as a member of the Aglossate group of the Anura renders all facts regarding its structure especially interesting.

For convenience of comparison in my description, I have followed Seydel ('95) in beginning my account at the choana or posterior nasal aperture. The choana opens from the back and upper part of the oral cavity as in other amphibians. It almost immediately shows clearly two main divisions, fig. 9, plate IV. Of these the superior or cavum nasale, *c*, figs. 2–9, has an ovoid section with the narrow end directed outward. The second division, the

[1] Contributions from the Biological Laboratories of Tufts College, under the direction of J. S. Kingsley, No. XVII.

inferior or lateral nasal canal, *ln*, is a long, flattened outpushing and lies more externally. The walls of the cavum nasale become thickened immediately and the epithelium is specialized for sensory purposes. The walls of the lateral nasal canal are thinner and contain no specialized cells except at its external end.

As we go farther forward, the lateral nasal canal suddenly widens laterally, still retaining its flattened condition, fig. 8, plate IV, and the external part becomes cut off from the main canal, forming a small and short blindsac. The epithelium of this posterior blindsac is not thickened or specialized, but is of the simple columnar type. This blindsac occurs in each series of sections and is apparently a constant structure. It is shown in outline in plate V and fig. 7 cuts through its anterior end.

The thickening seen to bound it internally in fig. 7 is merely the oblique section of the wall of the lateral nasal canal, which is here extending itself outward to connect with Jacobson's organ, and has nothing to do with the posterior blindsac itself.

In front of the posterior blindsac, the walls of the lateral portion of the lateral nasal canal become greatly thickened and its epithelium in this region assumes the same specialized condition as was found in the cavum nasale. This lateral portion now assumes a more nearly cylindrical shape and almost immediately leads away from the lateral nasal canal and forms the duct for the organ of Jacobson. From this duct, the organ of Jacobson extends forward, figs. 6, 5, 4, its anterior end being a little posterior to the middle of the whole nasal apparatus, plate V. It is the most external of the cavities connected with the nasal organ and lies on a lower plane than the rest. It is a rounded cone, viewed from below, and its outer walls have a flattened cylindrical section while its ulmen is broad and low.

The sensory epithelium is very thick, consisting of cells of an extreme columnar condition. The nuclei are scattered at various depths in the basal two-thirds of the cells while the free ends of the cells present the appearance familiar in this region in all Amphibians.

A little in front of the point of union of the duct of Jacobson's organ with the lateral nasal canal is the opening of the duct of Jacobson's gland, fig. 6, *jd*, the opening being at the inner angle of the organ. The gland itself, figs. 4 to 8, *jg*, lies below the cavum nasale and lateral nasal canal and is on a level with Jacobson's organ. Jacobson's gland, as in other Anura, is situated on the median side of the olfactory organ, and in front it extends laterally beneath the nasal cavities. It consists of convoluted cylindrical tubules lined with cubical or low columnar protoplasm, both nuclei and protoplasm staining deeply. It extends from a point somewhat in front of the planes of fig. 4 to that of fig. 8. Its duct passes from the anterior fourth of the gland to empty into the organ of Jacobson, Plate V. In fig. 4 there is a gland, *g*, which appears differentiated from the rest. It continues forward as a tube, and finally enters into the lateral nasal canal just posterior to the plane of fig. 2.

Farther forward (figs. 4–7), the lateral nasal canal expands externally into a secondary cavity, *ln*, which is lined with the same sensory epithelium as the cavum nasale, with which it remains in connection by the narrower and much depressed portion of the lateral nasal canal. This latter is lined with undifferentiated low columnar cells. More anteriorly, the secondary cavity gradually bends downward and inward so that its anterior region comes to lie below and in the median line of the rest of the olfactory apparatus as shown in Plate V.

From the anterior end of the lateral nasal canal the nasal canal continues forward as a flattened tube to the

external nares. Its epithelium throughout is of an undifferentiated character.

The cavum nasale is nearly the same size and shape throughout its whole length (*cn*, figs. 2–9). It is composed of specialized cells, and, in its grosser features, its histology is similar to that of Jacobson's organ. It has fine branches of the olfactory nerve[2] distributed chiefly to its internal part. These are in many cases too small to be seen with the magnification used. At its anterior end, it becomes separated from the lateral nasal canal (fig. 2) and soon ends as a small blindsac.

In fig. 5, the naso-lachrymal duct is seen. It can be traced for several sections, but as yet it has not formed its connection with the cavum nasale, as it apparently does in a later stage.

It is yet too early too say how much weight is to be placed upon the varying conditions of the olfactory organ in settling the vexed questions of the interrelationships of the Amphibia. Too few forms have as yet been studied to allow of any broader generalizations. Naturally one would expect to find more points of resemblance between the conditions occurring in Pipa and in Rana than between Pipa and the Urodeles, but from the foregoing account it will be seen that Pipa is about as widely removed in its nasal structure from the one as from the other. Certainly, if much weight is to be given these structures, naturalists are justified in the separation of the Aglossa from the other Anura.[3]

In more detail, these differences are as follows :—

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[2] Fischer ('43) has figured and described the olfactory nerve as double in this species; his figures representing the two components as arising side by side, directly from the brain. His account has often been quoted. I find, however, that the olfactorius arises by a single root and the nerve passes undivided through the ethmoidal cartilage, and almost immediately after its emergence breaks up into two superimposed branches which at once subdivide for distribution to the olfactory epithelium.

[3] A study of the structures in Dactylethra would prove very interesting.

In *Rana esculenta*, as described by Seydel, the cavum nasale and the nasal canal are not differentiated from each other, and, while the cavum nasale terminates in both in a cul-de-sac, this termination in Rana is in front of the external nares, in Pipa behind it. Then, too, the lateral nasal canal of Pipa is a structure differing considerably from that of Rana both in position and in histological differentiation. In Rana, Jacobson's organ lies beneath the main nasal canal (cavum nasale) and extends inwards as far as does any other structure connected with the olfactory region. In Pipa, on the other hand, it is not covered by any of the other nasal structures, and it is placed entirely on the external side of the whole nasal apparatus. From the whole course of the duct, so far as developed, the naso-lachrymal canal in Pipa will apparently connect with the cavum nasale, while in Rana it opens into the lateral nasal canal. The most posterior blindsac, given off behind Jacobson's organ, is apparently unrepresented in other Amphibians so far as I have studied the literature. Its lack of specialized sensory epithelium would seem to imply that it was of no great importance.

It seems unnecessary to make any comparisons with the Urodeles farther than to point out that in some respects Pipa seems to be intermediate between these and the Anura, especially in the relationships of what I have called the nasal canal, which agrees well in some respects with what Seydel calls the respiratory duct. Again the position of Jacobson's organ is nearer that found in Urodeles than that occurring in Rana and Pelobates.

Comparisons with the account given by Born ('77) of the conditions found in Pelobates show differences as great as those occurring between Pipa and Rana. One thing that is necessary in these studies is a new nomenclature of the parts. The terminology employed by

Born and by Seydel is hardly applicable to Pipa. I have, however, refrained from proposing any new names since I believe that this can only be done in a satisfactory manner by one who is making a comparative study of many different forms, and not by one who has only the limited perspective of a single species. Still it is well to point out what terms are employed by Born for the nomenclature adopted here which is based upon the terminology of Seydel.

Born distinguished three blindsacs which lie directly under each other; the upper being the largest and the middle the smallest. Born's "unterer Blindsac" may be compared to the Jacobson's organ in Pipa, while the "oberer Blindsac" is the cavum nasale. Born also finds another blindsac between the other two, which may possibly be compared to a similarly lying unnamed blindsac which Seydel found, the "a" of his figures, and possibly to the enlargement of the lateral nasal canal in Pipa. It is true that in Pipa it forms no blindsac, but it is specialized and forms an enlargement which, from the outside, might readily be taken for an actual blindsac. This enlargement is situated between the Jacobson's organ and the cavum nasale in Pipa, but is more internal in Rana.

[Published, March, 1897.]

LITERATURE.

'94, Arnold, G. A. The anterior cranial nerves of *Pipa americana.* Tufts College Studies, No. 1.

'84, Blaue, J. Untersuchungen über den Bau der Nasenschleimhaut bei Fischen und Amphibien. Arch. Anat. u. Phys., Anat. Abth., 1884.

'77, Born, G. Über die Nasenhöhle und den Thränennasengang der Amphibien. Morph. Jahrbuch, ii, 1876.

'43, Fischer, J. G. Amphibiorum nudorum neurologiæ specimen primum. Berlin, 1843.

'93, Lee, Stewart. Zur Kenntniss der Olfactorius. Berichte Naturf. Gesellsch. Freiburg i. B., vii, 1873.

'95, Seydel, O. Über die Nasenhöhle und das Jacobson'sche Organ der Amphibien. Morph. Jahrbuch, xxiii.

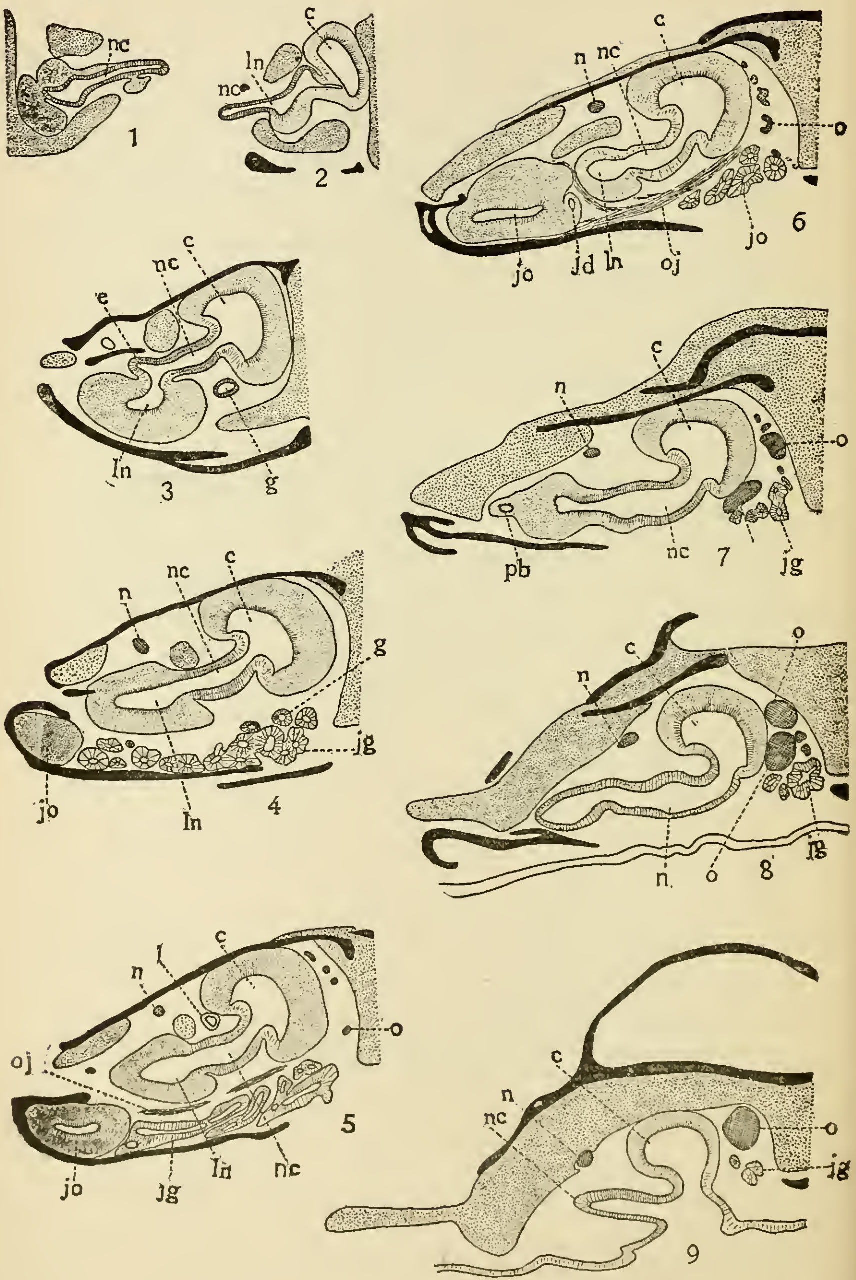
EXPLANATION OF PLATES.

Plate IV. Nine consecutive sections of the nasal region, fig. 1 being a short distance behind the external narial opening, fig. 9 passing through the internal nares.

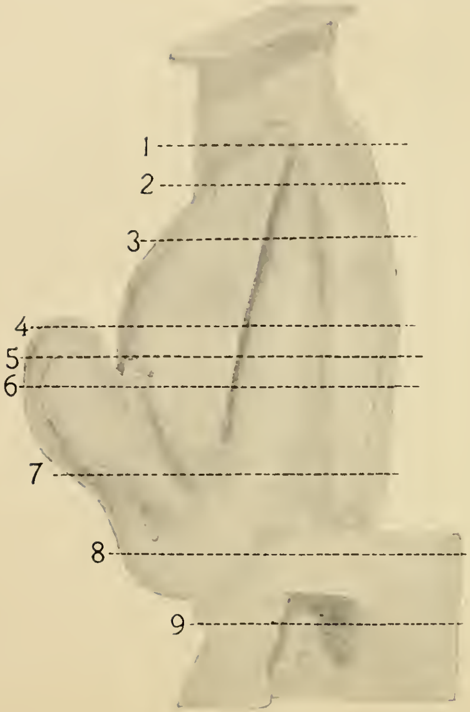
Plate V. *A*, Dorsal, and *B*, Ventral veins of a reconstruction of the nasal apparatus of *Pipa americana.* In *B* is shown in outline the limits of the internal cavity; while in both figures the planes of the sections shown in Plate IV are indicated.

ABBREVIATIONS.

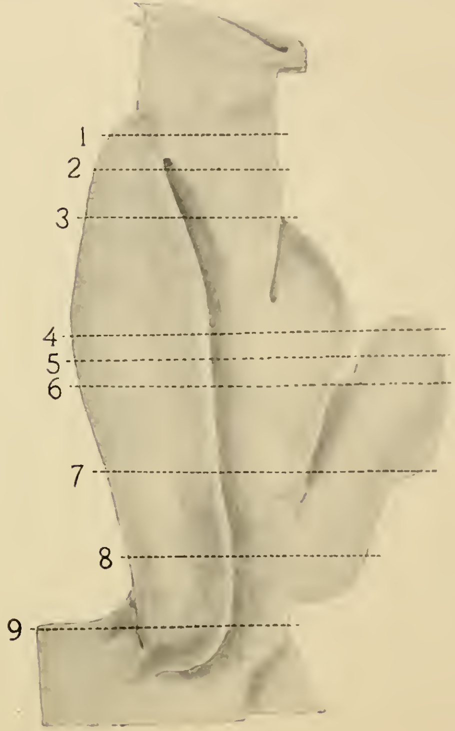
j. o. = Jacobson's organ.
l. n. = lateral nasal canal.
n. c. = nasal canal.
n. = branch of nasalis.
o. = olfactory nerve.
c. = cavum nasale.
e. = external portion of the nasal canal.
j. g. = Jacobson's gland.
j. d. = Jacobson's duct.
p. b. = posterior blindsac.
g. = differentiated gland.
l. = naso-lachrymal duct.
o. j. = branch of olfactory nerve to Jacobson's organ.



BANCROFT. NASAL ORGANS OF PIPA.



B



A

BANCROFT. NASAL ORGANS OF PIPA.

SUPPLEMENTARY REPORT ON THE MINERALOGY AND GEOLOGY OF ESSEX COUNTY.

BY JOHN H. SEARS,

Curator of Mineralogy and Geology, Peabody Academy of Science.

During the seasons of 1894, '95 and '96, the principal work in the geology of the county has been the study of the quartzite and interstratified beds in Lynnfield Centre and North Saugus and carrying the work southwest into Middlesex County in the towns of Reading, Wakefield, etc. The quartzite beds of North Saugus are, without doubt, parts of the basal Lower Cambrian and the knowledge of this formation has been extended southeast on both sides of the head waters of Penny brook to Saugus river. The quartzite and interstratified slates and coarse conglomerates of Lynnfield Centre are the basal members of the Carboniferous rocks, a continuance of the blocked area, No. 19 on the map, of Topsfield and Middleton. This work makes several changes necessary in the preliminary map published in 1893. As an evident mistake was made in the mapping of the contact of the hornblende-granite and the diorite areas of Marblehead and Swampscott, these have been more carefully worked out and remapped. Another correction made necessary is the separation of the hornblende-granites from the hornblende-biotite-granitite. This was not done when the map was published

on advice at the time, although I personally felt then that it would have been better to do so. Another correction is an addition to the augite-nepheline-syenite area. The augite-nepheline-syenite area in Gloucester and Rockport has been extended over two miles and remapped on the west side of Cape Pond. This work was greatly assisted by the Gloucester and Rockport street railroad work and the trenches opened by the Rockport water works, when numerous sections of the fresh rock were exposed thus affording good specimens of the rock for investigation. Many specimens from these outcrops have been collected and the data thus at our disposal have been of great help in tracing this rock formation. The trend of the augite-nepheline-syenite rock from Gloucester to these outcrops in Rockport and to Sandy bay and the Dry Salvages is in the usual northeast direction and unites in this area the augite-nepheline-syenite, the so-called black granite of the Rockport Granite Company's Quarry. Having thus traced the augite-nepheline-syenite in comparatively narrow area through the hornblende-biotite-granitite rock-mass, it is an indication that the syenite is the younger rock and cuts through the granitite without these recently seen outcrops; and, with the knowledge at our command when the geological map of Essex County was published, the small detached areas of the augite-syenite in this region seemed to be cut by the granitite, thus making the granitite apparently the younger rock. I have therefore, taken all of the maps remaining on hand at the Essex Institute and have made the necessary corrections to date in color.

These corrections may not appear important to the untrained eye; still they are so to the student and it at least brings the maps on hand correct to our best knowledge to the present time.

Revised scheme of numbers.
(+) Hornblende granite.
(12) Eruptive porphyritic gneiss.
(18) Cambrian rocks.
(19) Carboniferous rocks.

GEOLOGICAL SUCCESSION OF THE ROCK FORMATIONS OF ESSEX COUNTY, MASS., FROM THE EARLIEST TO THE MOST RECENT.

Archean, Laurentian gneiss, schists and sandstones, all crystalline, more or less contorted and highly metamorphic.

Pre-Cambrian, Arkoses, Hornblende epidote gneiss, Limestones, folded and metamorphic.

Lower Cambrian (Paleozoic) conglomerates, quartzites, slate and limestone, Georgian Olenellus, etc.

Eruptive (igneous) rocks, muscovite biotite granite.

Hornblende granite.

Hornblende biotite granitite.

Eruptive porphyritic gneiss.

Quartz augite diorite.

Quartz hornblende diorite.

Essexite nepheline rock and aegirite ditroite schieffer.

Hornblende diorite.

Elaeolite zircon syenite and augite nepheline syenite.

Hypersthene augite basalt dyke rocks (eobasalt).

Augite olivine basalt dyke rocks.

Diallage gabbro dyke rocks.

Diallage augite olivine gabbro dyke rocks.

Aegirine Tinguaite dyke rocks.

Aegirine syenite dyke rocks.

Ancient volcanic rocks, rhyolite breccias, banded rhyolite, corhyolite.

Hornblende diorite dyke rocks.

Hornblende augite porphyrite, feldspars from one to three inches long, dyke rock.

Aphanitic diorite dyke rocks.

Aplitic granite dyke rocks.

Felsite porphyry dyke rocks (eorhyolite).

Bostonite porphyry (sanadin dyke rock).

Quartz porphyry dyke rocks (eorhyolite).

Liperite dyke rock (eorhyolite).

Vitrophyre dyke rock (eorhyolite).

Keratophyre lava (anorthoclase rock), a sheet covering the rhyolite breccia and banded rhyolites on Marblehead Neck.

Paleozoic Era, Carboniferous Period, Permo-Carboniferous Epoch. Very coarse ferrugineous conglomerates and grits, blue shales, sandstones and black limestone, that is fossiliferous.

Surface deposits.

Cenozoic Era, Pleistocene Period, Pre-glacial Epoch. Pre-glacial clay beds, covered by glacial boulder till (older diluvium) occurring in long ridges or drums, which lie in the general direction of the rock striations.

Cenozoic Era, Pleistocene Period, Glacial Epoch. Scratched, grooved, polished and striated surfaces of ledges and stones, drift boulder clays. Terminal moraines as drums and drumlins. Eskers, valley sands and clays deposited in ice dammed seas. This determination may include inter-glacial epochs and a post-glacial epoch.

Psychozoic Era, Post-Terrace period, Present Epoch. Peat-beds, river alluvium. Evidence of subsidence, submerged forest trees, cones, nuts and fruits; also many hundreds of wings and fragments of beetles and other insects submerged to a depth of fourteen and one-half feet below high water mark. For full description, see Bulletin of the Essex Institute, Vol. XXVI, 1894.

PEABODY ACADEMY OF SCIENCE,
Salem, March 29, 1897.

SANDSTONE DIKES ACCOMPANYING THE GREAT FAULT OF UTE PASS, COLORADO.

BY W. O. CROSBY.

INTRODUCTION.

THREE years ago, Whitman Cross[1] first directed the attention of geologists to the fact that dike-like masses of sandstone occur in the granite of the Pike's Peak massif, forming a belt about one mile wide extending north-northwest from the vicinity of Green Mountain Falls, in Ute Pass, along the southwest side of the narrow Manitou Park basin of sedimentary rocks (Silurian and Carboniferous). Among the most important characteristics of the dikes noted by Cross are the following :—

1. The dikes have a general trend parallel to the belt in which they occur; are approximately vertical and often appear as a complex of nearly parallel fissures with many branches and connecting arms; and vary in width from mere films to two or three hundred yards, the largest being a mile or more in length, and forming rugged ridges with narrow crests which contrast markedly with the gently sloping hills of granite about them. In short, "in all formal relationships to the enclosing

[1] Bull. Geol. Soc. America, 5, 225-230;
U. S. Geol. Survey, Pike's Peak Folio.

rocks these bodies are as typical dikes as any of igneous origin."

2. The rock of the dikes is a fine and even-grained aggregate of sand grains varying in degree of induration from a normal sandstone to a dense hard quartzite, but throughout of a remarkably massive and uniform character. The induration is mainly due to limonite; in the quartzitic portions, however, there appears to be some secondary silica, although a distinct enlargement of the quartz grains is rare.

During the past summer of 1896 I was able to devote several weeks to the investigation of the sandstone dikes and the great displacement to which I have found them to be genetically related. To the dikes described by Cross I gave only sufficient attention to become familiar with their characteristics; and then endeavored to trace the series southeastward through Ute Pass to Manitou and beyond.

The sedimentary formations of the Manitou area embrace, from below upward, as described by Hayden, Cross, and others:

1. A basal sandstone which is usually forty to fifty feet thick, white or gray for the lower ten to fifteen feet and dull red or brown above, only rarely of arkose character, but frequently more or less glauconitic. 2. This sandstone, which may be referred provisionally to the Potsdam, becomes calcareous upward, passing into red, cherty limestones, and these into a massive gray limestone having a thickness of several hundred feet. The limestones are throughout more or less magnesian and contain recognizable traces of a Lower Silurian (Ordovician) fauna. 3. This great Manitou limestone series is overlain without apparent unconformity by the Fountain (Carboniferous) beds, one thousand to possibly

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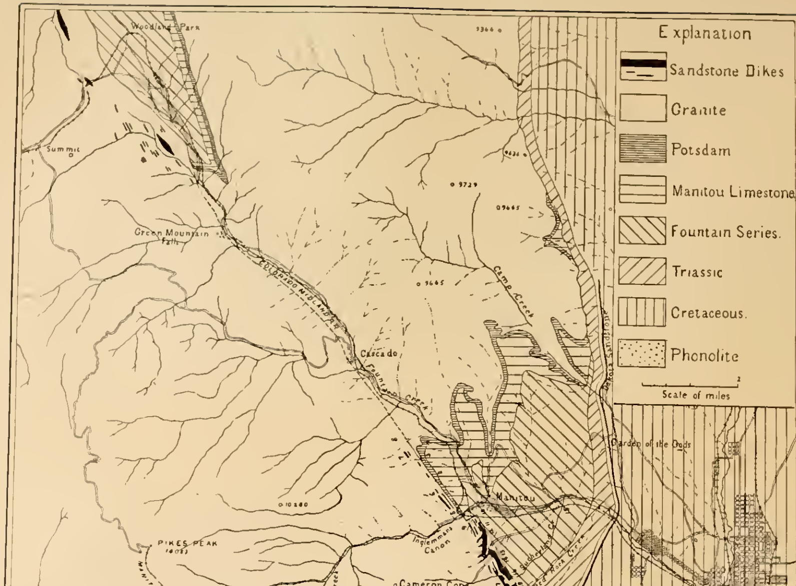


Explanation
Sandstone Dikes
Granite
Potsdam
Manitou Limestone
Fountain Series.
Triassic
Cretaceous.
Phonolite
Scale of miles
Woodland Park
Summit
Green Mountain Falls
Colorado Midland R.R.
Cascade
Fountain Creek
Camp Creek
Dakota Sandstone
Garden of the Gods
Manitou
Inglemann's Canon
Sutherland Cr.
Red Rock Creek
Colorado Springs
Pikes Peak
Manitou & Pikes Peak R R
Cameron Cone
Ruxton Creek
Lake Moraine
Bear Creek
Cheyenne Creek
Dead Lake
Seven Lakes
Beaver Creek
Cheyenne Mt

fifteen hundred feet in thickness—a remarkable complex of red and white arkose sandstones, grits and conglomerates. 4. The red sandstone series (Triassic), a thousand feet or more in thickness. 5. The white, variegated and gypsiferous Jurassic strata. 6. The Cretaceous series, beginning with the massive and conspicuous Dakota sandstone.

Each of these formations is cut off on the south by the great fault which skirts the northeastern base of the Pike's Peak massif. This profound displacement, which must be regarded as a dominant factor in the geological structure of the region, and to which we undoubtedly owe, in the main, the Manitou embayment of sedimentary rocks and the exceptional elevation of the Pike's Peak massif as compared with the Front Range to the North of Ute Pass, gained early recognition and is clearly indicated on Hayden's map of the Manitou area[2], the principal features of which are reproduced in the map accompanying this paper. Although the traveler through Ute Pass now leaves the sedimentary rocks and passes on to the granite within two miles of Manitou, there is, apparently, no reason to doubt that the sedimentaries were once continuous with those of the Manitou Park area, which now begin a mile north of Green Mountain Falls or nine miles from Manitou, and coincidentally with the sandstone dikes described by Cross; and it is altogether probable that the fault by which Cross has bounded the Manitou Park sediments (Potsdam, Manitou limestone and Fountain series) on the southwest is a direct continuation of that which, cutting across the strike of the beds, is so much more conspicuous in the Manitou area. This great displacement, which divides

[2] Ann. Rep. U. S. Geol. and Geog. Survey, 1874, p. 40.

very obliquely the entire Front Range and the beds lying upon either flank of the range and sloping away from its crest, may therefore be appropriately designated the Ute Fault. Erosion has cut deeply enough over the top of the arch to remove the sedimentary rocks from the downthrow as well as the upthrow side of the fault. The Ute Fault cuts every formation of the region from the fundamental granite and the Potsdam to the Laramie, and in its maximum throw must exceed the aggregate thickness of the Paleozoic and Mesozoic terranes; and its completion, at least, must date from relatively late geological times.

SANDSTONE DIKES NORTHWEST OF MANITOU.

The contact of the granite and sedimentary rocks is obscurely exposed in the southeast bank of Ruxton Creek, beneath the bridge of the Colorado Midland Railroad. It is exposed again and more satisfactorily in the cut on the railroad at Iron Spring Station (Map, 5). The cut and the hillside just above it show the Potsdam beds in normal succession — white sandstone, red sandstone with glauconitic layers, and red calcareous strata passing into the normal Manitou limestone. Near the granite the beds are tilted by the drag of the great fault to a dip of 90° which rapidly subsides to a northeast dip of about 45° degrees at the northeast end of the section. The actual contact can be located within a foot or two; and along this line both the granite and sedimentary rock are much crushed, the bedding of the sandstone is almost obliterated, and all the indications suggest a fault.

Within two hundred feet southwest of the fault the granite incloses several sandstone dikes. One of these is exposed in the railroad cutting about forty feet from the fault and the base of the Potsdam. It is fifteen feet

thick and hades southwest. An uncertain thickness of granite separates this from a dike fifty and possibly one hundred feet wide of undetermined hade. Both dikes are entirely typical in lithological character, but in consequence of the deep disintegration of the granite they are not well exposed. The sandstone is the usual dull red, blotched and spotted with white where the iron oxide has been reduced and leached out; and it seems to be somewhat glauconitic.

From this point a gulch extends northwesterly along the line of the old South Park trail, between the long slope of disintegrated granite and the abrupt, sharp-crested hill of the Potsdam sandstone and Manitou limestone, which still maintain a high northeast dip. The indications are that the first dike mentioned follows the bottom of the gulch and the fault-line closely. On the col at the head of the gulch several irregular dikes of sandstone, with a maximum width of at least forty feet, outcrop obscurely in the granite; and immediately above on the northeast are the highly inclined Potsdam sandstone and red and gray cherty limestones, the lines of snow-white chert in the lower limestone contrasting strongly with the deep red matrix.

The northwest-southeast ridge of sedimentary rocks, which the fault-depression places *vis à vis* with the abrupt border of the granite, is, within a distance of about one and a half miles from Iron Spring Station, divided by transverse gulches into four hills (1, 2, 3, 4). On passing down either of these gulches we see that the high northeast dip due to the fault quickly gives way to the normal dip of the region (S. E. 10°–15°), and this rising of the formations to the northwest brings the basal beds above the present surface at the northwest end of the fourth hill.

Opposite the middle of the second hill, a few feet southwest of the trail (6), is a small prospect shaft about fifteen feet deep on a sandstone dike three to four feet wide. It trends northwest-southeast, approximately, and hades southwest about 5°. The rock is much crushed, with evidences of shearing along the walls. On the trail, opposite the northwest end of the second hill, a dike at least six or eight feet wide is exposed between disintegrated granite walls. The sandstone of the dike is white on the northeast side and red (highly ferruginous) on the southwest. These two outcrops make the sandstone dikes unquestionable for this locality; and the appearances suggest their origin in the sheeting of the formations along the great fault-line.

On the second spur of granite opposite the third hill, and several hundred feet southwest of the probable line of the fault, are two large sandstone dikes (7). The southwest dike is fifty to one hundred feet wide and separated by about twenty feet of granite from the narrower northeast dike. The larger dike gives off a branch one to two feet wide on the southwest side. Toward the northwest end of the third hill the granite appears beneath the Potsdam beds, the downthrow being no longer sufficient to conceal the base of the Potsdam; and it is clear that from this point northwest the fault now lies wholly in the granite. The Potsdam sandstone is non-glauconitic here and not unlike that of the dikes, except that it is, in the main, rather coarser. Some of it is blotched and spotted with white in the manner so characteristic of the dike rock.

From this point and the last sedimentary outcrops northwestward an occasional small fragment of sandstone in the disintegrated granite shows that the dikes are not wholly wanting. About half way to Cascade (8)

and about three hundred feet west of the trail, a dike of sandstone, which may be ten or fifteen feet wide, outcrops quite plainly for a few rods. Beyond this is the front of the great moraine which stretches quite across the valley — an immense accumulation of granite bowlders and débris, and beyond this, as far as Cascade, no farther traces of the sandstone dikes were observed. Between Cascade and Green Mountain Falls I have not searched for dikes, assuming that Cross had covered this ground. Although it appears probable that thorough search would reveal traces of the sandstone dikes along the entire distance from Manitou to Green Mountain Falls, it is a very significant fact that they are practically coterminous with the sedimentary rocks, alike of the Manitou and the Manitou Park basins.

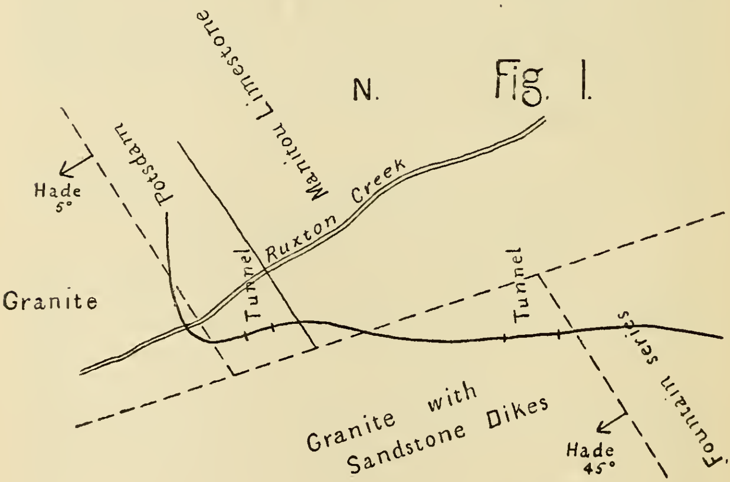
SANDSTONE DIKES SOUTHEAST OF MANITOU, BETWEEN RUXTON CREEK AND BEAR CREEK.

Having demonstrated that northwest of Manitou the great fault is bordered by sandstone dikes on the southwest as far as it is by the sedimentary rocks on the northeast, and somewhat farther, I naturally anticipated that the same relation would be found to hold southeast of Manitou; but I was not prepared for the great development of sandstone dikes in that direction which my observations disclose.

Immediately south of Ruxton Creek the structure is rather complicated; and it appears to me that the best explanation of this complexity is found in a transverse fault in the valley of Ruxton Creek, as shown on the map (9) and more in detail in Fig. 1. This transverse displacement, which may be called the Ruxton fault, evidently breaks the great Ute fault; and it affords the simplest and most natural explanation of the fact that the

Potsdam sandstone and Manitou limestone, which have such a prominent development north of Ruxton Creek, are wholly wanting south of this line, the throw of the Ute fault south of the Ruxton fault being great enough to conceal all the sedimentary formations below the Fountain series. The Ruxton fault not only breaks and displaces the Ute fault, but south of the former the latter has a greatly increased southwest hade (inclination to the vertical).

Immediately east of the bridge over Ruxton Creek and

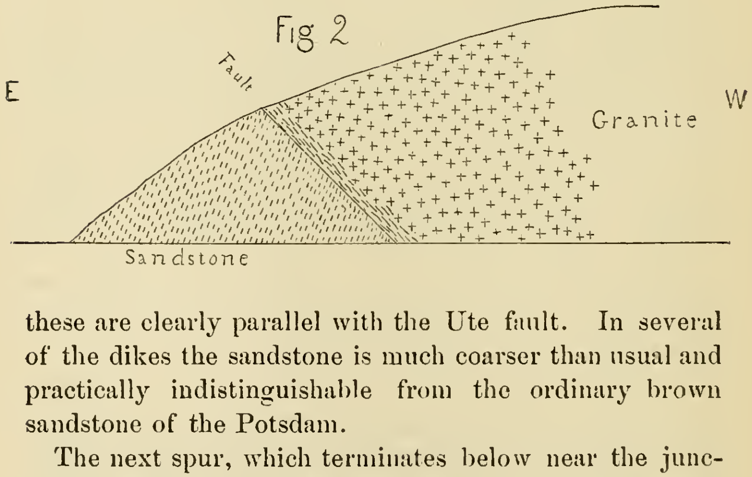


Avenue the railroad passes through a tunnel about one hundred feet long, which with the open cuts at either end gives a continuous section of nearly four hundred feet. The western end of this section shows a red and gray mottled and banded sandstone, which, although non-glauconitic or nearly so and closely resembling the sandstones of the dikes, must be correlated with the Potsdam. The prevailing dip of this sandstone is southwest 60°–80°; but it is highly disturbed, crushed, and mineralized

in consequence of its proximity to the faults. Above the tunnel is a craggy and highly brecciated mass of quartzite, which extends down through the tunnel. On either side of this, and extending twenty to fifty feet beyond the ends of the tunnel are soft, decomposed, ochrey rocks, apparently ferruginous and manganiferous clays occurring as residuary impurities of a crushed limestone (base of the Manitou limestone). East of the tunnel, sandstone like that of the west end of the section dips northeast 60° at first and then changes abruptly to dips, away from the railroad on either side, of 10° to 30°. East of this tunnel (Fig. 1) is another about two hundred feet long with open cuts giving again a continuous section of about four hundred feet, the distance between the two sections being about four hundred and fifty feet, following the railroad. The second section shows in the cut west of the tunnel, or for about one hundred feet, the variegated and structureless dike sandstone. The tunnel and first fifty feet of the eastern cut are in coarse granite with numerous small (one to four feet) dikes of sandstone. A very regular dike cuts the tunnel at the east portal, widening downward from one to three feet, with a westerly hade of 10° to 20°. Most of the dikes are transverse to the tunnel, but they run in all directions and are extremely irregular. Midway of the eastern cut the granite overlies the soft, red and white sandstones of the Fountain series, the contact hading southwest about 45°, while the sandstone dips northeast 70°, approximately (Fig. 2). Both rocks, and especially the granite, show much crushing near the contact. This is very obviously the continuation of the Ute fault, crossing the railroad obliquely and trending in a southeasterly direction, with the Fountain series on one side and the coarse granite with sandstone dikes on the other.

Higher up on the spur intersected by the western tunnel sandstone dikes outcrop obscurely; and the south wall of what appears to be the most southerly dike is exposed in two prospect holes, showing, like the great fault, a strong hade to the southwest. All along this line of contact the granite has a finely brecciated or semi-crushed appearance, with much slickensiding along the joints. On the spur above the second tunnel this contact, not well exposed, is found again in the same direct line. Between this contact and the tunnel eight hundred feet to the north is granite with occasional inclosed masses of foliated diorite and numerous dikes of sandstone. About three of the dikes are large (10 to 50 feet) and

Fig 2



these are clearly parallel with the Ute fault. In several of the dikes the sandstone is much coarser than usual and practically indistinguishable from the ordinary brown sandstone of the Potsdam.

The next spur, which terminates below near the junction of Ruxton and Manitou Avenues (10), is all drift in the first bench south of the railroad, but at the head of this bench, about eight hundred feet from the railroad, the Fountain beds can be seen dipping gently to the east; and on the steep front of the next bench a large sandstone dike outcrops obscurely. The same conditions were noted

on the next spur (11), which rises directly above the Barker House. A small prospect hole at the head of the first bench shows the coarse, soft Fountain beds *in sitú*. The sandstone dike, one hundred feet or more in width and coarser than the normal, outcrops more prominently here, giving the second bench an almost precipitous front. These breaks in the profiles of the spurs are directly in the course of the Ute fault as followed from the second tunnel; the topography and geologic structure are evidently in agreement; and the sandstone dikes closely accompany the fault.

The spur running southwest from the Midland Depot (12) is drift underlaid by Fountain beds to the head of the first main bench, about one thousand feet (estimated) from the railroad. Here, on the steep slope or front of the second bench the great sandstone dike has a width of fully one hundred and fifty feet. Both the north and south granite walls are obscurely exposed, fifty to one hundred feet of granite separating the dike from the great fault. Some of the dike rock is quite coarse and indistinguishable from the normal Potsdam; and the dike is divided by some very prominent slickensided shear planes. As usual, the prospect openings afford valuable exposures of the geologic structure.

The first important gulch east of Ruxton Creek is that running south-southwest from the Midland Depot. On the western slopes of this gulch, above the main detrital cones, the dike sandstone outcrops very strongly on several spurs, extending about one-fourth mile up the gorge from its mouth, or approximately one half mile from the railroad. Good exposures are afforded by road-cuttings; and the indications are favorable to the view that the great dike turns slightly on reaching the gulch and extends with a breadth of one hundred to two

hundred feet obliquely along the side of the gulch. On the uphill side, at least, the dike is very much branched, surrounding and enclosing many large masses of granite; and there appear also to be large dikes of sandstone extending southwest into the granite. The sandstone is mostly fine, but some of it is decidedly coarse; and in general it is much mottled. Traces of a true bedding are indicated at various points in alternating layers of coarse and fine material. The numerous shear planes show a strong southwest hade. On the east side of the gulch the sandstone outcrops strongly about one hundred yards below its southern limit on the west side; and extends thence eastward along the steep slope (13) above the more gently sloping bench of the Fountain series. The dike sandstone seems to extend to the bottom of the slope, and its lower edge is concealed by drift; but on the uphill side the boundary can be traced at intervals, although the fine grained dark brown granite occurring here is easily mistaken for the sandstone. If all the sandstone on this slope is to be referred to one dike, it must be from two hundred to three hundred feet wide. A quarry-like excavation affords a good exposure of the sandstone, whicn is of entirely normal character. The distribution of sandstone in the slide material indicates branching along the upper edge of the dike; and one dike four feet thick is clearly exposed, hading southwest about 45°. Near this is a dikelet two to four inches wide of a very dark brown sandstone which is not easily distinguished from the inclosing granite; and this is but one of many instances where the brown color of the sandstone is most marked next the granite; suggesting the biotite of the granite as a source of a part at least of the cementing and coloring iron oxide of the sandstone.

In its eastern extension this great dike appears to split

up. Thus, on the high, steep and smooth hill (14) directly south of the Denver and Rio Grande Depot I found that a broad sandstone dike crosses the lower northern slope of the hill; all the upper and main part of the hill, including the crest, is granite; the col leading from this hill to the higher summit on the southwest shows two sandstone dikes, probably fifteen to twenty feet wide and separated by twenty to thirty feet of granite, the more southern dike, especially, showing a strong southerly hade; and, finally, several hundred feet farther southwest up the ridge is a small dike (10 feet?).

Below the sandstone dikes and the fault-line the Fountain beds form as usual a gently sloping plain or terrace and exhibit near the mountains low east to southeast dips (5° to 10°). But farther down the slope toward the railroad, in the numerous excellent outcrops and monuments, the beds dip due south 20° to 25°, seeming thus to show in the diminished dips toward the fault-line the lifting effect or upward drag of this great displacement. In the long deep cut on the railroad, however, the dip is east-southeast as usual and not exceeding 10° or possibly 15°. The Ute fault is clearly, in all this part of its course, a thrust fault; and hence this pronounced roll of the Fountain beds, and the general disturbance of the stratification, may be regarded as normal features. Returning toward the mountains by the spur or mesa that slopes up in a southwest direction from the limekiln (15) east of Manitou, and leaving the gulch containing the little cemetery on the west, the following dips were observed. Near the railroad the Fountain beds dip E. by S. about 10°. Farther south this changes to S. or S. by E. about 20°. Quite clearly a low anticline runs about southeast and pitches in that direction one-third to one-half mile from the fault and the base of the moun-

tains. Nearer, the beds change gradually to a north dip 3° to possibly 5°; and this very gentle dip continues to within about two hundred feet of the fault, when the beds are suddenly flexed up to a nearly vertical northeast dip.

At the fault, which is quite clearly exposed in the bottom of the gulch on the east side of the mesa, the vertical or overturned Fountain beds are in direct contact with a large dike of sandstone. The north edge of the dike shows a trend N. W.–S. E. and a southwest hade of at least 30° and possibly 45°. The dike is mainly fine white sandstone, but abundantly mottled with red. It is exposed almost continuously in the bottom of the gulch for a breadth of about seventy-five feet. On the west side of the gulch the upper or south contact may be easily traced, showing the same southwest hade as the lower contact. The dike is here, however, much branched, inclosing large masses of granite and penetrating the granite in numerous sharply defined dikelets one-fourth inch to one foot thick. In some parts of the sandstone numerous small angular fragments of granite are inclosed. About one hundred yards above this sandstone dike is another with the same southwest hade, and a surface breadth of twenty to thirty feet. These two sandstone dikes cross the ridge or spur on the east side of this little gulch to the next gulch beyond, in which the fault is not clearly exposed; but the Fountain beds are seen within forty feet of the north dike dipping north about 10°. The north or fault dike is here nearly if not quite one hundred and fifty feet wide, and seems to be nearly vertical. The sandstone is light gray blotched with red, as usual, with many highly polished and striated slickensides or shear planes. There are also some indications of faulting along the south side of this dike. Two to three hundred feet south of this dike is the other,

which is probably not more than ten to fifteen feet thick and seems to retain its strong southwest hade.

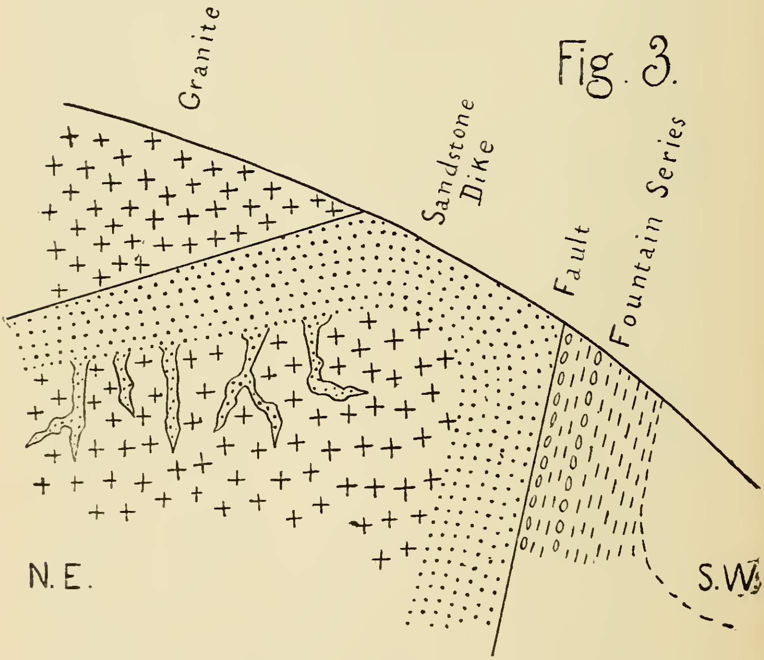
The south dike does not seem to cross the next spur, but across its steep north end is some float that may be referred to the great north dike; and on passing around to the northeast corner of this spur, where it slopes down to the next little gulch, there is a great development of sandstone. It meets the granite along a northeast-southwest line and quite certainly extends under the granite at a low angle. In part the sandstone is quite distinctly stratified, in beds one to two feet thick, and these are sometimes minutely laminated. On the south side of the outcrop and near the granite, the dip is toward the granite, indicating that the sandstone underlies the granite; but toward the north side of the dike the beds dip slightly in that direction. In all cases the dip is low—5° to 15°. Apparently we have here the original stratification of the sandstone. The granite has been thrust obliquely over it, crushing and disturbing the (then) half consolidated sandstone, but not wholly obliterating its bedding. The sandstone is traversed in all directions, but especially parallel to the bedding planes, by highly perfect slickensides.

In the bottom of the gulch, below the dike sandstone, the Fountain beds are seen tilted 90° or more. Farther down, both in this gulch and the next one, the Fountain beds quickly subside to a northerly dip of 10° to 15°. The great fault evidently hades southwest at a very low angle, so far as the southwest wall of the dike is concerned, but in the bottom of the gulch the dike sandstone, where it comes nearest to the Fountain beds (the nearest outcrops being thirty to forty feet distant), is inclined at the same angle (S. W. 85°). The stratification is very distinct, and the sandstone beds are evidently

beat sharply down along the fault plane, which presumably hades southwest 5° (from vertical) at this point.

Crossing the next spur brings us to the valley of Sutherland Creek (16), a living stream which supplies the reservoir near the limekiln. On the west of the valley where it issues from the mountains, the Fountain beds, as before, are tilted to a S. W. 85° dip. This out-

Fig. 3.



crop must be near the fault, for within a few yards south of it the dike sandstone is seen also dipping S. W. 85°, while higher up the dike sandstone dips S. W. only 5° to 10°. These outcrops are thus in perfect harmony with those of the preceding gulch, and the accompanying section (Fig. 3) may be regarded as expressing the

general relations of the formations for both localities. It will be observed that the flexing of the beds is entirely normal—upward on the downthrow side of the fault and downward on the upthrow side. From the top of the curve the dike sandstone dips gently (5° to 10°) into the hill. The outcrop, in part nearly horizontal, can be followed right around the hill to the extreme south side. The sandstone seems to become gradually thinner and to die out finally in the bottom of the lateral gulch. The upper contact is well exposed in a prospect hole and is seen to be much broken by minor transverse faults, and both sandstone and granite are much crushed and slickensided along the contact. Below the main body of sandstone the granite is a complete network of sandstone dikes from three inches to several feet wide running in all directions. Apparently, the granite has overridden the sandstone bed, and the unconsolidated portions were forced down into the cracks in the granite below. Some of the sandstone is quite coarse and gritty, with many feldspar grains; and there are slickensided surfaces all through it. In this hill and the preceding, the sandstone is mainly brown. Gray sandstone is most characteristic of vertical or highly inclined strata, probably because that position is most favorable to the circulation of the meteoric waters which have bleached the strata. The stratification is in part as perfect as in any of the sandstones of the region—a fine and even lamination. This dike is exposed again, with essentially the same characters, on the east side of the creek; but before gaining the crest of the first main ridge it ends abruptly, apparently cut off by a transverse fault.

Going up the west side of the valley, we find south of the lateral gulch, first granite and then at least two hundred feet of sandstone of the usual dike character. Its

southern contact with the granite is exposed and hades steeply to the southwest; and some small branches penetrate the granite. The dike trends about E. S. E. and re-appears in force on the east side of the valley, at the base of a dark cliff of granite (17). This dike has here a maximum width, though possibly enclosing some granite, of about four hundred feet. On the crest of the spur it is narrowed down to about two hundred feet; and six hundred feet of granite separate it from the fault, beyond the abrupt eastern termination of the fault dike. All the indications favor a strong southwest hade; and on the east slope of this spur it is seen very clearly that the fault hades southwest at a very flat angle (45° or more). The granite passes obliquely up over the edges of the Fountain beds, which for a breadth of several hundred feet are overturned about 10°.

On the first branch of the next main spur, we cross, from the fault southward, nearly eight hundred feet of granite, and then, high up on the united spur, come to about one hundred feet of sandstone. A few yards farther east, on the second branch of the spur, this sandstone seems to broaden out to four or five hundred feet. The next spur (18) is a short one which the fault cuts low down on its end slope; and, immediately south of the fault and the outcrops of the Fountain beds, are four hundred, and possibly five or six hundred, feet of sandstone. The south wall is cut by a prospecting tunnel; and it can be clearly seen, both in the tunnel and in the ledge above it, that four feet of granite separate the main body of sandstone from a parallel two-feet dike of sandstone. The hade is S. W. about 45°. This tunnel spur is directly at the head of the little or western Red Rock valley. All the way down the west side of the valley the Fountain beds dip E. S. E. about 30°; while on

the opposite (east) side the Red Beds (Triassic) dip in the same direction 40° to 60°, the dip increasing rapidly eastward.

On the next main spur east of the tunnel the southern boundary of the dike sandstone is found in the same direct line and evidently hades southwest. Northward from this contact the sandstone is exposed continuously for a breadth of nearly if not quite five hundred feet, or to the extreme end of the spur, with no distinct appearance of bedding. The Ute fault clearly forms the northern boundary of this great dike, every exposure on this line showing the dike sandstone in contact with either the Fountain series or the Red Beds. In following this boundary eastward it is found, on the west side of the last spur referred to, to be shifted to the northward about three hundred feet by an obliquely transverse fault, the course of which is readily traced by a superb zone of crush breccia. This zone, fifteen to twenty feet wide and vertical, is a complete breccia of the dike sandstone in angular fragments of all sizes, mingled with the quartz pebbles and cobbles of the Fountain conglomerate, and with the finer part of the Fountain series as a paste. Near the re-entrant angle where the fault should enter the dike, the crush breccia terminates abruptly against a transverse fissure hading S. E. about 20° and containing a thin seam of reddish brown clay and sandstone. It is probable, however, that the fault continues obliquely across the spur along some offset parallel line not now clearly exposed.

On the next spur to the eastward the dike sandstone seems to form a comparatively narrow band, possibly one hundred feet wide, across its steep north end. North of it are the Red Beds, and south of it all is granite. Beyond this spur is the main west branch of Red Rock Cañon. Along the west side of this gulch is another very

plain transverse fault, the Red Beds on the east side being jogged to the south or up the gulch fully one thousand feet and terminating just north of two mining tunnels. On meeting the transverse fault the sandstone dike appears to turn and border it on the west side, a very plain indication that these transverse faults are contemporaneous with the Ute fault.

The mesa east of this gulch is probably underlain by Red Beds right up to the steep granite slope, with only slight indications of dike sandstone along the fault line. In fact, the slide of disintegrated granite hides all contact phenomena for the next half mile, or to where the main or quarry ridge of red sandstone meets the granite slope (20) with a nearly vertical dip (E. 85°). The next and last red ridge, about six hundred feet farther east, is swerved to the east as it nears the granite, approaching the granite at the last very obliquely. Between Red Rock Cañon and Bear Creek no satisfactory evidence of sandstone dikes has been observed; but the Ute fault appears to cross Bear Creek without deflection or offset, and the Jurassic and Cretaceous beds meet it in the same manner as the last of the Red Beds, each formation in turn experiencing a sharp flexure parallel with the fault and consequent eastward deflection of its outcrop. East of the Cretaceous (Dakota) hogback, forming the gateway of Bear Creek, the Cretaceous beds form first a sharp and unsymmetrical syncline followed by a gentle anticline.

SANDSTONE DIKES IN THE VICINITY OF CHEYENNE CREEK.

From Bear Creek southeast for one and a half miles I was unable, for lack of time, to follow the fault line; but my observations were resumed at South Cheyenne Creek, working first northwest and then southeast.

Exactly at the mouth of South Cheyenne Cañon, where the carriage road crosses the creek and the burro trail from the terminus of the electric railroad joins it (21), a large and entirely typical sandstone dike outcrops on both sides of the creek. On the west side it is sixty, if not seventy-five feet wide and both walls can be located. The north wall is clearly exposed by the roadside and shows sandstone penetrating and enclosing the coarse red granite; while on the south side the sandstone is involved with a dark green, fine grained, crushed igneous rock. Crossing the end of the mountain toward North Cheyenne Creek, I found a good outcrop in a prospect hole seventy-five to one hundred feet above the creek. This excavation does not expose either wall; but it does show an inclosed mass of the compact greenish igneous rock. It is dike-like in form, eighteen to twenty-four inches thick, and hades southwest 45°; but it is also clearly traversed by dikelets of the sandstone one-fourth inch to two inches in diameter. Hence the altered trap must be older than the sandstone dike. The dike sandstone is quite friable in part, and some of it rather coarse, even containing pebbles of quartz and granite. Appearances indicate a wide dike here, and it is readily traced down the slope to North Cheyenne Creek and up the west slope of the valley. Immediately north of the dike is a large but obscure outcrop of a soft or friable white sandstone which weathers buff, yellow, red and purple (mainly yellow). It agrees very well with the Dakota sandstone of Bear Creek, while it is entirely different from the adjacent dike sandstone.

The great shear plane so conspicuously exposed on the west side of South Cheyenne Cañon (22) demands attention here. It rises from the creek level near the toll gate, passes around the end of the mountain at a height of about two hundred feet, and appears to be traceable east

and west across both branches of Cheyenne Creek, being indicated in the topography and also in the contrast presented by the granite — dark red and brown to gray and variable above, and a lighter, brighter red and coarser texture below. The really striking exposure is on the northwest side of South Cheyenne Cañon, where it appears as a perfectly straight, sloping and open crack or fissure, with a southwest hade of 60° to 70° (from vertical). The shear faces are plane, smooth or even polished, and slickensided in the line of hade (southwest). The fissure is six to fifteen inches wide and occupied by some broken granite, but mainly by what appears to be the dike sandstone, though some of it might be comminuted granite. Examination with a lens leaves no doubt that the filling is chiefly the dike sandstone. This prominent shear plane is clearly a feature or part of the Ute fault; and was probably once connected with the sandstone dike already described which crosses the ridge between the two creeks only a short distance below the fissure.

On the northwest bank of North Cheyenne Creek the sandstone dike crops with a breadth of certainly one hundred feet. On the slope above is a very large and prominent outcrop, showing a width of fully two hundred and fifty feet (23). Neither wall is clearly exposed, but the boundary on the southwest or granite side can be readily traced by the float and also by the prospect holes. The lower hole is in the sandstone only a foot or two from the granite and shows an irregular streak of granite six to twelve inches wide running vertically through the sandstone and parallel with the wall. In the same hole some of the sandstone appears to be glauconitic. Toward the middle of the dike are some masses and layers of conglomerate with water-worn quartz pebbles up to an inch in diameter, exactly like what may be observed in

different parts of the Manitou basin at the base of the Potsdam, and much of the sandstone is rather coarse.

Farther northwest the dike passes beneath a broad, steep slope of talus from the granite cliffs above. It can be traced, however, in an occasional prospect hole and in float. About half a mile or so from the creek is a quite conspicuous outcrop of white Cretaceous (Niobrara) limestone in beds nine to fifteen inches thick with thinner shaly partings. It has been quarried somewhat and shows a dip to the southwest 45°. Overlying it is a brown and highly fossiliferous limestone with a bituminous odor when freshly broken. Between this limestone and the granite cliff is about two hundred feet concealed by talus, but with indications that the limestone is bordered by the sandstone dike with a breadth of one hundred feet more or less, the Benton shales and Dakota sandstone being concealed by the fault at this point. In the next one-fourth mile, going west, the dike seems to die out completely, no float showing in the slide; but the white limestone is exposed in several prospect holes and ledges almost to the head of this valley, which extends nearly a mile northwest from the creek to the summit of the mesa. The dip is constantly southwest, 45° approximately. Probably these Cretaceous strata, like the Fountain beds farther west, have been overturned by the oblique upward thrust of the granite.

On tracing the great sandstone dike southeast from South Cheyenne Creek it is found well exposed on the first spur with a breadth of one hundred to possibly two hundred feet. Neither contact is exposed, but the granite contact can be located within a foot or two at several points. On the north are extensive but obscure exposures of the gray fossiliferous limestone and the compact white limestone. The bedding is not clearly exposed,

but the gray limestone is south of the white, as before. The sandstone dike can be traced by float across the lower slope of the next spur toward the mountain road. Beyond the Cheyenne Mountain road my observations have not extended, and I have no information as to whether or not the Ute fault, with or without the accompanying sandstone dikes, can be traced farther in that direction. The topographic indications are certainly very favorable to their occurrence, at least as far as Deadman's Cañon; but probably the extensive mesa and slide deposits make satisfactory outcrops few and far between.

The Ute fault series of sandstone dikes has been proved for a distance of over twenty miles, and an extreme length of thirty miles or more is certainly by no means impossible. Professor Stone's observation, cited by Cross, demonstrates the existence of another extended system of dikes in the Pike's Peak region. This occurs in the valley of Turkey Creek, south of Cheyenne Mountain, and is quite certainly not connected with the Ute fault. According to Stone, the Turkey Creek system has been located for about twelve miles, and through his courtesy I am able to cite a third system, since he writes me that a short sandstone dike occurs about half a mile east of Nipple Mountain, near Wilbur Station, southeast of Cripple Creek. These facts indicate the probable discovery of other systems, as the region is more thoroughly studied.

ORIGIN OF THE SANDSTONE DIKES.

Mr. Cross has briefly discussed this topic, without arriving at a definite conclusion. He recognizes that these sandstone dikes are radically distinct in character and origin from those described by Diller in California, and asserts that the known facts do not indicate the source

of the sand; that the facts do show that the fissures of this dike complex were filled by fine quicksand injected from a source containing a large amount of homogeneous material; that such a system of fissures, large or small, with their many intersections, could not remain open to be filled by any slow process; that the uniformity and purity of the material filling fissures, varying from mere films on cleavage planes of orthoclase grains in the granite to dikes several hundred yards in width, could not have resulted from infiltration; and, finally, that none of the sedimentary formations of the region can be regarded as probable sources of the material.

My study enables me to accept all of these generalizations, except the last one. The main purpose of the preceding detailed descriptions of the dikes which have come under my special notice is to set forth the facts which the true theory of the dikes must explain. The most important of these are: first, their very evident close relationship to an important zone of displacement; second, the homogeneity of the materials and the general absence of stratification in the dikes; third, the great maximum and average widths of the dikes.

The relations of the dikes to the great Ute fault are indisputable. Not only is the fault at most points closely accompanied by one or more dikes; but nowhere have I been able to find any trace of the dikes more than a few hundred feet (500 to 1000 feet) distant from the principal line of displacement. Of course it can not be positively asserted now, in the absence of sedimentary deposits in those districts, that the dikes of the Turkey Creek and Nipple Mountain areas accompany lines or zones of displacement; but it is certainly a fair presumption that they do, in view of the fact that they are, apparently, in every other respect, identical in character

with the Ute fault series. That these fissures, unlike the relatively narrow ones described by Diller in California, have not been filled from below becomes perfectly obvious when we reflect that the inclosing rock formation is a deep-seated plutonic. The homogeneity and purity of the sandstone, and especially the absence of feldspathic or argillaceous material, make it impossible to regard the dike rock as a fault breccia or as due in any way to the comminution of the wall rock. Ruling out this theory, and infiltration, we are forced to the conclusion that the fissures have been filled from above. But of this theory two principal forms naturally suggest themselves. First, the fissures antedate the deposition of the sand, existing as cracks in the sea-bottom which were filled by the slow process of sedimentation. Second, the cracks post-date the deposition of the sand, but antedate its lithifaction to form a firm sandstone; and the unconsolidated sand subsided and flowed down into and filled the fissures. As Cross has pointed out, the necessary slowness of the process is a valid if not a fatal objection to the first view; and it also fails to account for the very general absence of stratification in the dikes and of more or less water-worn fragments of the wall-rock. Furthermore, if these traps for sediments opened on the marginal portion of the sea-floor, coarse material washed into them would be protected from further attrition, and the observed fineness and homogeneity of the dikes could not exist.

By this process of elimination we are forced to the consideration of the view that the fissures were formed after the granite had been covered by the sedimentary deposits and before their complete consolidation, the unconsolidated portions naturally contributing to the filling of the fissures and the formation of the dikes. In the opinion of the writer this view is not, *a priori*, improb-

able. On the contrary, it postulates conditions which must be realized now and then—a normal type of geological accident. The next step, therefore, is to test its applicability to the actual conditions of the present problems. There are two questions especially which the acceptance of this explanation would require to be answered in the affirmative. First, are there, among the sediments of the Manitou and Manitou Park basins, any that, aside from structural features like stratification, which would of course be obliterated during the filling of the fissures, present a reasonably close agreement in character (composition and texture) with the sandstone of the dikes? Second, may we reasonably assume that these sediments were, in part at least, unconsolidated, or imperfectly consolidated, at the time when the fissures were formed? The only sandstone formations that need be considered in this connection are the Potsdam, Carboniferous, Triassic and Dakota. The Laramie and Monument Creek beds are so far removed in every sense — lithologically, stratigraphically and topographically — as to place them quite beyond the possible purview of the problem. Of the four sandstone horizons first named, the last three bear no special resemblance to the material of the sandstone dikes. Cross insists upon this lack of agreement for the Carboniferous or Fountain beds, which are ruled out especially by their prevailing coarseness and arkose character. It is almost as difficult to find in the bright red Triassic sandstones an equivalent of the reddish-brown and gray sandstones of the dikes; and similarly with the white or buff Dakota sandstone, weathering to bright yellow, orange and red tints. Furthermore, the derivation of the dike rock from any of these higher sandstone horizons would imply the existence of sandstone dikes in the lower sedimentary forma-

tions; but that the dikes are strictly limited to the granite no student of this area will question. The Potsdam beds, on the other hand, resting as they do directly upon the granite, are in an extremely favorable position, stratigraphic and otherwise, for filling fissures in the granite.

In the foregoing descriptions of the dikes I have several times stated that the rock resembles the Potsdam sandstone, and this resemblance is frequently indicated in my note-book. In fact, I became convinced before the field work was finished that the two formations are lithologically identical, except that the dike rock is usually unstratified and rarely glauconitic. The glauconite, however, characterizes only a small part of the Potsdam strata, and is often wanting altogether. This agreement holds for both the Manitou and Manitou Park basins. From the sandstone dikes north of Green Mountain Falls I crossed the Manitou Park Basin to the highly inclined Silurian and Potsdam outcrops along its eastern edge, and found that a part of the latter formation is practically indistinguishable from the dike rock. Cross describes the sandstone of the dikes as of fine and uniform texture; but this is also the prevailing character of the Potsdam beds, and my observations show that the dikes, as a whole, embrace much coarse sandstone and some conglomerate, and that their range in texture is fully equal to that of the Potsdam. Furthermore, the structural contrast does not hold universally, for at several points, as I have noted, and including also a part of the great dike north of Green Mountain Falls, the dike sandstone is plainly stratified. The facts that no sandstone dikes have been observed in the Potsdam beds, and that, so far as known, the dike rock is never calcareous and rarely glauconitic, suggests its derivation from the lower rather than the calcareous and glauconitic upper layers of

the Potsdam. The basal member of the Potsdam, it will be remembered, is a white to gray sandstone more or less interstratified or blended with the prevailing reddish brown variety. It is not only calcareous or argillaceous, but it contains insufficient iron oxide for its thorough cementation, and has very clearly never been exposed to volcanic influences. We can, therefore, readily conceive that it remained unconsolidated for a long time after the lithifaction of the overlying beds. The dike rock is absolutely indifferent to the changes in the character of the neighboring sedimentary formations, showing no appreciable variation as, in succession, from Manitou southeast to Cheyenne Cañon, the Potsdam, Silurian, Carboniferous, Triassic and Dakota beds abut against or border the great fault.

The close association of the dikes, throughout the entire belt, with the great displacement, and their unvarying lithological similarity to the Potsdam sandstone, have suggested to me that the dikes probably date from the formation of the Ute fault; that the fault probably dates from the time when the Potsdam beds, which are still at the base in part of a more or less friable character, were imperfectly consolidated and covered the entire region; that the fault, as is likely to be the case with a great displacement, was not simple, but that a moderate breadth of the granite and overlying formations was traversed by a series of parallel fissures; and that the dikes resulted from the sinking of the Potsdam sandstone and sand into the fault-fissures. Such local subsidences of the friable sandstone would naturally be attended by a more or less complete obliteration of the bedding. That the structure of the Potsdam beds has been locally effaced under shearing and compressive or plicating movements can be seen at a point on the east side of Ute Pass a few rods below

Rainbow Fall. On the south side of a small lateral gulch a sharp, inverted flexure of the basal Potsdam beds can be seen (Fig. 4). Throughout the flexure the sandstone is beautifully slickensided in various directions precisely as in the sandstone dikes. The extremity of the sharp lower curve is not clearly exposed, but on both this and the main curve above it the bedding is much obscured or completely effaced, and the sandstone closely resembles the dike rock.

Many of the sandstone dikes are one hundred feet or

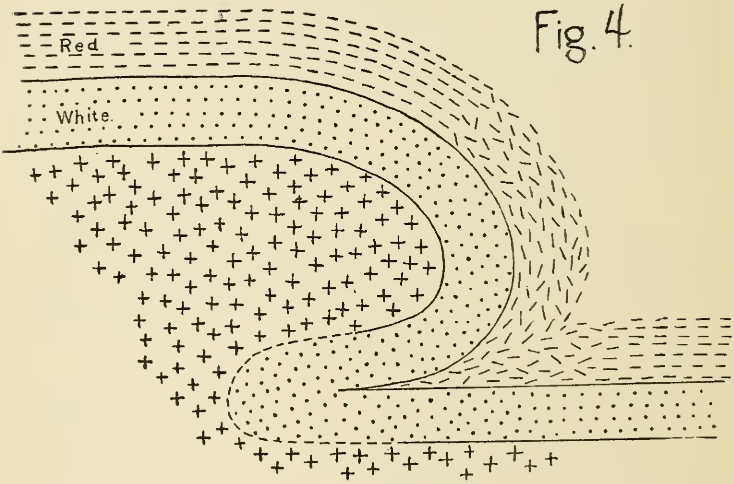


Fig. 4

mor in breadth, and the largest, as described by Cross, five hundred to one thousand feet; and certainly no single feature of the dikes is more significant than the great breadth of individual examples. Although presenting, apparently, an insuperable obstacle to all the other suggested explanations of the sandstone dikes, it offers no difficulty whatever to the theory proposed here, for we have only to make the extremely probable supposition that sheets of granite of varying width and bordered by

complementary faults have settled down relatively to the bordering masses, bearing with them their loads of Potsdam sediment. The very moderate thickness of the Potsdam beds (40 to 50 feet) would seem to set a correspondingly narrow limit to the depth of these wide dikes; and yet some of them actually outcrop in such strong relief as to prove a depth of several hundred feet at least. Escape from this dilemma is afforded, however, by the reasonable supposition that the sandstone was sufficiently unconsolidated to flow under the great pressure to which it was exposed; and also by the facts noted in the great dike on Sutherland Creek, where the sandstone, still distinctly bedded, has been strongly folded and tilted to a vertical or overturned position (Fig. 3). Compression between converging walls of granite might, obviously, increase the vertical thickness of the sandstone to almost any extent. An actual flowing of the sand into the chasms opened beneath it is plainly indicated in the case of all the narrower dikes and dikelets and their intricate branches.

Of course it is a logical though by no means a necessary deduction from this theory that some of the sandstone dikes should break the granite-Potsdam contact, disturbing or obliterating the bedding of the sandstone. No undoubted instances of this have been observed in a somewhat thorough examination of this contact throughout the Manitou area, but it is not impossible that they exist.

Concerning the geological age of the sandstone dikes no positive statements are warranted by the facts now at our command, although the explanation of the dikes here proposed affords us a clue, since they must be coeval with the Ute fault. This displacement was certainly not completed until Post-Cretaceous times, but it may well have begun at a much earlier period, since, as Cross has stated,

orographic movements have affected this region many times since the early Paleozoic epoch. It is certainly improbable that the Potsdam sandstone was, in any Post-Cretaceous epoch, so imperfectly consolidated as the formation of the minor sandstone dikes in the manner here proposed, at so late a date, would require. I suggest therefore that they probably date from some comparatively early movement along this line. In this connection it may be noted that the numerous slickensides in the dikes show movement after the lithifaction of the sand, and therefore long subsequent to the first formation of the dikes.

It is a necessary corollary of the view developed here that the sandstone dikes of Turkey Creek, Nipple Mountain, and possibly other localities in this region, indicate formerly overlying Potsdam strata, and thus throw light upon the former distribution of that formation. They are narrow linear *Gräben* formed along sheeted zones, or more literally trenches in which portions of the Potsdam sediments have been buried below the present plane of erosion, and thus preserved. As erosion cuts more deeply, all the sandstone dikes will disappear, as they practically have done already between Cascade and Green Mountain Falls, or where the Potsdam beds are wanting.

The sheeting of the granite which this theory demands is by no means a purely theoretical feature. On the contrary, this type of jointing may be regarded as more or less characteristic of the granite of Ute Pass, as may be so well seen at Rainbow Fall. And two striking illustrations of sheeted zones in a distant part of the Pike's Peak Massif accompany the recent monograph by Penrose on the Mining Geology of Cripple Creek.[3]

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[3] 16th Ann. Rep. U. S. Geol. Survey, part 2, plates III and IV.

Two other modes of occurrence of sandstone are, in the opinion of the writer, sufficiently dike-like to demand recognition here. One of these is that described by Prof. J. D. Dana,[4] in the quartzite of Dutchess Co., N. Y., where the rock between vertical joint or shear planes has, perhaps before its complete induration, been reduced by compressive and shearing movements to a structureless mass of sandstone — a dike of sandstone in walls of sandstone, a species of crushed zone, dike-like structurally but not dynamically or in the sense of being intrusive. Professor Dana says, "The obliteration of the bedding by impulses of lateral pressure is well illustrated in the quartzite near Poughquag, where the bedding is beautifully distinct and nearly horizontal. In two or three places, in the course of a long section of the well stratified beds, there are narrow vertical portions of the whole height of the section exposed, which have lost entirely the bedding, and are divided only by vertical joints." Such a vertical strip "looks a little way off like a dike of igneous rock, yet it is only a narrow vertical section of the stratified quartzite, in which, under the lateral pressure, fractures were produced, and where, consequently, the successive movements shook down and re-arranged the sands adjoining, so as to obliterate the planes of bedding and substitute vertical planes."

The other mode of occurrence of sandstone in dike form is really one phase of unconformity, where sediments deposited over an eroded surface fill fissures and chasms of various forms. Later erosion may remove the sedimentary deposit and leave the ancient floor intact, with the dike-like roots of the sediments remaining in it. Irving[5] has described and figured sandstone dikes of this

[4] Am. J. Sci. (3) *3*, 181-182.
[5] Monographs U. S. Geol. Survey, v, 292-3.

type in amygdaloid on the shore of Lake Superior, near Duluth, and I have described and figured equally striking "root" dikes of sandstone and conglomerate in the granite of the Boston Basin[6], which have been exposed by the erosion of the Carboniferous conglomerate of the Nantasket area. No student of our coastal geology can doubt that other fine examples are now forming where the numerous deep and narrow chasms due to the erosion of trap dikes or of the rock between contiguous joint planes, as in the case of the chasm called Purgatory at Newport, R. I., are being filled with sand and gravel, during the gradual subsidence of the land; and unquestionably dikes of this type were developed on a grand scale when the rugged topography due to pre-glacial and early glacial erosion was wiped out by the drift deposits.

It appears, then, that although the term sandstone dike is a comparatively recent coinage, four distinct types now claim recognition, and may be classified as follows:—

1. Dikes formed in antecedent or original fissures (erosion crevices and gorges) by sedimentation. The "root" dikes of Duluth, Boston Basin, and doubtless, many other localities, belong here.

2. Dikes formed in subsequent or secondary fissures:

(*a*) By earthquake movements forcing quicksand upward from a bed below the horizon of the dikes. This type includes the dikes described by Diller[7] in California and Hay[8] in Nebraska; and the fact that the ejection of quicksand from fissures is a common accompaniment of earthquakes indicates that many other examples must await discovery.

(*b*) By the settling down of sand from overlying

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[6] Occas. Papers, Boston Soc. Nat. History, IV, pt. 1, 76–77.
[7] Bull. Geol. Soc. America, *1*, 411.
[8] Bull. Geol. Soc. America, *3*, 50–55.

deposits into earthquake and fault fissures and chasms. The only examples so far recognized are those of Ute Pass and the Pike's Peak massif; but according to the explanation which I have proposed this is probably not a rare type, especially in the Rocky Mountain region.

(*c*) *In situ*, by compressive and shearing movements. The examples described by Dana belong here, and practically all sharply defined crushed zones accompanying faults and joints. This type is the commonest of all; but, as noted, the material is not intrusive, and hence they are dike-like in their structural but not in their genetic relations.

BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXVIII.

1896.

SALEM, MASS.
PRINTED BY THE ESSEX INSTITUTE.
1898.

Salem Press:
The Salem Press Co., Salem, Mass.
1898.

CONTENTS.

BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 28. SALEM: JANUARY,—JUNE, 1896. NOS. 1–6.

ANNUAL MEETING, MAY 18, 1896.

THE annual meeting was held in Plummer Hall, this evening, at 7.45 o'clock; Vice President A. C. Goodell, jr., in the chair. The record of the last annual meeting was read by the Secretary.

The reports of the Secretary, Treasurer, Auditor, and Librarian were read, accepted and ordered to be placed on file.

Vice President Edward S. Morse spoke in approval of portions of the Secretary's report, particularly of that part in reference to the method pursued in electing new members and also what was said about interesting young members to aid in arranging our collections.

The report of the committee on nominations was presented by the Chairman, Richard C. Manning, and it was

Voted, To proceed to the election of officers for the

ensuing year. Messrs. William L. Welch, John H. Sears and Frank Cousins were appointed by the chair to distribute, collect, assort and count votes. This committee reported that the whole number of ballots cast was 92.

The ticket presented by the committee on nominations was as follows:

PRESIDENT:

ROBERT S. RANTOUL.

VICE-PRESIDENTS:

ABNER C. GOODELL, JR.,
DANIEL B. HAGAR,
EDWARD S. MORSE,
ALDEN P. WHITE.

SECRETARY:

HENRY M. BROOKS.

TREASURER:

WILLIAM O. CHAPMAN.

AUDITOR:

HENRY M. BATCHELDER.

LIBRARIAN:

CHARLES S. OSGOOD.

COUNCIL:

GEORGE H. ALLEN,
WILLIAM H. GOVE,
THOMAS F. HUNT,
FRANCIS H. LEE,
RICHARD C. MANNING,
S. ENDICOTT PEABODY,
DAVID PINGREE,
FREDERIC W. PUTNAM,
CHARLES S. REA,
GEORGE M. WHIPPLE.

Of the ninety-two ballots cast for President

62 were for Robert S. Rantoul,
15 " " Alden P. White,
13 " " Abner C. Goodell, jr.,
2 " " DeWitt S. Clark.

Mr. Rantoul was therefore declared to be elected.

The others nominated were unanimously elected with the exception of a few scattering votes among one or two of the Vice-Presidents and one or two members of the Council.

Report of the Secretary, May 18, 1896.

In looking at the record of the past year we must all feel the great loss the Society sustained in the death of its honored President, the Rev. Edmund B. Willson. It will be remembered that at our last annual meeting Mr. Willson presided and, to all appearance, was in his usual health, having come from Petersham that very day, in order to be with us in the evening. He made, as you know, upon that occasion, a brief but excellent address in accepting the Presidency for another year. We little thought then that we were so soon to lose him. Within a fortnight from that time he was stricken down in his pulpit in the North Church, having just finished delivering his thirty-sixth anniversary discourse, and in the course of a few days passed away.

After the able and appreciative address of Vice-President Rantoul in Academy Hall, I do not feel that it is desirable for me to add another word; but perhaps I may be permitted to say that my personal relations with Mr. Willson extended over the whole time he lived among us, for I was a member of the North Society when he first came to Salem, and in fact proposed his name to the Committee of the Society, as the man for pastor, which circumstance led to his settlement over the North Church.

The name of another valued member of the Institute comes to my mind, Mr. George D. Phippen, who died on the 26th of last December. He was one of the original members of this Society and served in various offices from time to time. He was the faithful Treasurer for many years, and afterwards Auditor. He was always greatly interested in the success of the Society. He wrote many interesting historical articles in the early volumes of our Collections. He was not only a well-read historical and

genealogical writer, but an accomplished botanist and well acquainted with various branches of Natural History. Many who listen to me will call to mind his fine garden in Bridge street, which for years afforded so much pleasure to his numerous friends. Whatever he undertook he did well. We all remember him as a quiet, unassuming and genial man. I feel that I knew him well, for I served two years with him in the Salem Bank, and in those two years, he taught me more than I had learned in all the years I had been at school, so that I have felt that I was under great obligations to him, and I am glad of the opportunity now offered, to pay my feeble tribute to his worth. It is a singular fact that these two good men, although differing somewhat theologically, had much in common, and often conferred with each other on religious matters and duties. This I know to be a fact, for Mr. Phippen himself so informed me, and it shows that truly religious people can differ in such matters, without being offensively partisan.

I trust I shall be pardoned for these few personal allusions, for I could not otherwise do even imperfect justice to those of whom I have been speaking.

Since the last meeting one hundred and thirty persons have become members of our Society, while eighteen have died, and fourteen have withdrawn, leaving the membership at the present time nine hundred and four. The additional members include, as life members, Mrs. John L. Gardner of Boston, Wm. D. Sohier of Boston, Amory A. Lawrence of Boston.

These are the members who have died during the year:

Henry Blaney, Theodore Brown, Hubbard Breed, Thos. J. Hutchinson, Wm. Mack, Amos H. Johnson, Edward H. Payson, Geo. D. Phippen, Wm. A. Bowditch, William G. Webb and Edmund B. Willson of Salem, Mrs. Eliza

D. Clement of Peabody, Mrs. Frederic Fry of Bridgeport, Conn., Octavius Howe of Beverly, Eustace C. Fitz, Alexander H. Rice, Henry W. Williams, Edward Wigglesworth of Boston (life member). One honorary member has died, William Wetmore Story of Rome, Italy.

It will be noticed that, in spite of losses, our membership has increased. There is no reason why we should not have a still larger increase, if some of our members would interest themselves to help us in this way. There are doubtless many men and women who would be glad to join us, if they understood they would be welcomed. As a general rule, people will not, of their own accord, come forward and ask to be admitted. That question was settled long ago, and our membership was declining before we adopted the new process of inviting people to become members, by electing them. If we had kept on in the old way, instead of having nine hundred members to-day we should have had but two hundred.

As I have often remarked, I think it is very important to enroll as many young people as possible, as members. Eleven of our members, who have died this last year, were upwards of seventy years of age.

There is another matter, in this connection, which I might as well speak of now. Have we not, among our members, some young men or women who would devote a little time occasionally, in assisting us in the arrangement of our Library and other departments of the Institute? We have, for instance, an immense collection of manuscripts of all kinds, and many of great value: letters, deeds and other legal documents, mercantile papers, genealogical minutes, etc., etc. Some have been inserted in books, but require to be indexed; many have not been arranged at all, and many have never been read, to ascer-

tain their value. Now, with our present force and means, it would take perhaps twenty years to render these manuscripts available.

Perhaps this is asking too much in these bicycle days, and some may think, we are always begging for something, either donations or money or members. But let such consider the fact that, in the last report of the great British Museum of London, that institution was begging for more room. Indeed all similar institutions are always in want of more room or more money and, with the exception of the Essex Institute, seem to get it.

The free course of lectures in Plummer Hall the past winter has been as popular as ever. The lecturers have been, Gamaliel Bradford, Thomas H. Mullen, Samuel Cabot and Arlo Bates, of Boston, Prof. T. C. Mendenhall of Worcester, Edwin Reed of Cambridge, Edward Atkinson of Brookline, and Rev. D. S. Clark of Salem.

The Women's Local History Class have continued their meetings weekly since the summer vacation, and are as much interested in their work as ever. Those who desire further information about this class can receive it by application to the Secretary, Miss Helen D. Lander.

There have been twenty-five regular meetings of the Society, three meetings of Committees and two of Directors, one special meeting, December 28, to take action on the death of Mr. G. D. Phippen, and another, June 16, on account of the death of President Willson. A memorial meeting in honor of Mr. Willson was held November 7, in Academy Hall, when an interesting and eloquent address was given by Vice-President Rantoul upon the life and character of the President. Vice-President Morse presided at this meeting and made remarks appropriate to the occasion.

The evening meetings of members in the library room

the past season have been well attended. Papers have been read by the following persons:

Miss Mary Ropes on "John Horn or Orne."

Miss Rosamond Symonds on "Salem Common," "Winter Island" and "The Neck."

Gardner M. Jones on "Public Libraries."

Miss Annie L. Warner on "Birds of Winter."

Gilbert L. Streeter, two papers on "Salem before the Revolution."

J. H. Choate, J. H. Sears, Harry R. Peach and John Robinson exhibited specimens under the microscope one evening, but owing to a severe storm, but few persons were present. The papers read were discussed by some of the members interested, and valuable facts brought out.

We have had a larger number of visitors during the past year than at any former period. The officers and assistants had about as much as they could do the last summer and fall to attend to callers: various large organizations, such as the Society of Christian Endeavor, the Universalist Christian Union, and the Masonic Society of Knights Templars,— each of these numbering thousands. Then there were the Auburndale Review Club, the Dorchester Woman's Club, the Randolph Literary Club, the New York Literary Club, besides several schools and classes. This will account for the great increase in the number of those who have visited the old first meeting house,— nearly 18,000, double the number who have ever visited it in the same time before. It is a curious fact that many people call for the key to this church, who have not time to examine our collections. They have to go to Marblehead or the Willows. Some of the schools and classes, before mentioned, have been addressed by Vice Presidents Morse or Rantoul, in Academy Hall, and other members of the Institute have conducted the strangers to places of historical interest about the city.

The inquiries of visitors to our rooms are sometimes quite amusing. This very season, at least two persons have asked to see the "Scarlet Letter," Hawthorne found in the Custom House. They had been told we had it. Once before, a lady said she had seen it some years ago in our rooms—she felt pretty sure about it, but it might have been at the Court House she saw it. Another person asked to see the instruments of torture which were used upon the witches. One lady asked if we could give information about an ancestor who came over with the early settlers; but did not know his name. She was anxious to be a Colonial Dame. Another wanted information to establish her right to be a "Daughter of the Revolution" or a "Daughter of the *American* Revolution," I have forgotten which. She knew she had a great grandfather in *some* Regiment, but could tell nothing farther.

The donations to the Cabinets the past year have been four hundred and twenty-nine from one hundred and seven donors. Among the more important donations was a fine copy in oil, from the original portrait of the Hon. Benjamin Goodhue, the first member of Congress from this District. This was the gift of his great granddaughter, our associate, Mrs. Sarah Goodhue King of New York City. Francis H. Lee, Esq., donated a rare old Dutch water-color view of Salem, at an early period. This picture was bought at a shop in Holland. From the estate of Esther C. and William Mack we received a miniature and a portrait of the Rev. John Clark, D.D., a former minister of the First Church in Boston, who was a native of Salem. We already had Dr. Clark's gold watch in our collection. From the same source we also received portraits of Judge Elisha Mack and wife, painted by Charles Osgood.

From John S. Williams, Esq., a large and valuable collection of manuscript papers, among them an original

letter of Dr. Doddridge of England. There were also, in this lot, forty-eight old MSS. sermons, of the last century.

At the last annual meeting, Mr. Ross Turner referred to the condition of many of the old portraits in the Society's rooms, as requiring rebacking and restoring, to put them in a proper condition for preservation. The matter was referred to the Fine Arts Committee. This Committee has since had the work thoroughly done, and now all the portraits and other paintings belonging to the Society are in first class order.

The Publications of the Society have progressed favorably this year. The first part of Vol. 31 of the Historical Collections has been issued, and the second part, concluding the volume is now in press and nearly ready for issue. The first part of Vol. 27 of the Bulletin has been published, which includes the Annual Report for 1895. There does not appear to be much of a supply of good material fitted for publication in the Bulletin. The Visitor's Guide was issued under the imprint of the Essex Institute. The first of the special catalogues of the Institute Library was issued early in the year and was devoted to the Special Library on China. Among the leading articles in the Collections were:

A Historic Ball Room, by Robert S. Rantoul; List of Salem Vessels issued by Timo. Orne, John Nutting, Jr., and John Higginson, 1757, 1758, compiled by Geo. H. Allen; Lady Deborah Moody, by Mrs. Henry W. Edwards; Some Localities about Salem, by Henry M. Brooks; Memoir of Edmund B. Willson by Robert S. Rantoul.

Which is respectfully submitted,

HENRY M. BROOKS,

Secretary.

Report of the Librarian.

The additions to the library for the year (May 1895 to May 1896) have been as follows:

By Donation.

Folios,	38
Quartos,	204
Octavos,	1,412
Twelvemos,	308
Sixteenmos,	181
Twenty-fourmos,	101
Total of bound volumes,	2,244
Pamphlets and serials,	4,510
Total of donations	6,754

By Exchange.

Folios,	3
Quartos,	8
Octavos,	263
Twelvemos,	5
Sixteenmos,	5
Total of bound volumes,	284
Pamphlets and serials,	1,646
Total of exchanges,	1,930

By Purchase.

Folios,	3
Quartos,	5
Octavos,	16
Twelvemos,	1
Total of bound volumes,	25
Pamphlets and serials,	433
Total of purchases,	458
Total of donations,	6,754
Total of exchanges,	1,930
Total of additions,	9,142

Of the total number of pamphlets and serials 2,116 were pamphlets and 4,462 were serials.

The donations to the library for the year have been received from two hundred and four individuals and ninety-two societies and governmental departments. The exchanges, from fifteen individuals and two hundred and forty-nine societies and incorporated institutions, of which one hundred and twenty-four are foreign; also from editors

and publishers. The largest single donation was from the estate of the late General Cogswell.

The library now contains about 70,000 bound volumes and something more than 200,000 pamphlets.

There is little for the librarian to say in his report this year except to reiterate and emphasize what he has said for the past five or six years. The library is greatly in need of funds to make it more available and useful to the public. It needs a fire-proof stack room for the storage of books and it needs a catalogue. These needs appeal to the generously disposed as a most excellent method of benefiting the large number of persons who annually visit the rooms of the Institute, and the still greater number that would be attracted thither by increased accommodations and facilities. We are confident the aid will come in time, we hope in a comparatively short time, and when it comes the Institute will be able to be of greater service to the public in many ways. Until that time we must be content to go along as at present doing a little work each year and preparing the way for the future changes.

The interest in the library is fully maintained. It is frequently consulted and is of great use to students who are pursuing special lines of study and research. It does not aim to be a popular library, but pursues its work on different lines from the Public Library and Salem Athæneum, and by so doing avoids duplication, and relieves the libraries named from making any attempt to supply those books which are within the special line of work marked out by the Institute.

The quickened interest in the Institute is shown in its largely increased membership. Let us see to it that this interest is not allowed to flag, or grow cool, from any want of effort on our part.

CHAS. S. OSGOOD,
Librarian.

Treasurer's Report.

RECEIPTS.

Balance from last report,		$804 75
Received from Invested Funds,	$3,246 26	
" " assessment of members,	2,382 00	
" " life membership fees,	150 00	
" " publications,	400 51	
" " Almy, Bigelow & Washburn, for reception fund,	25 00	
" " contributions for restoring pictures,	150 00	
" " other sources	241 64	6,595 41
		$7,400 16

EXPENDITURES.

Salaries of secretary, assistant librarian and janitor,	$2,598 15	
Fuel,	205 50	
Lighting and water,	129 12	
Shrubs and labor,	62 80	
Postage and express,	167 37	
Supplies,	103 81	
Storage,	37 80	
Furniture and fixtures,	65 09	
Repairs and new furnace,	288 60	
Restoring pictures and frames,	689 25	
Lecture expenses,	25 61	
Books,	449 42	
Publications and printing,	620 26	
Athenæum expenses,	168 36	
Miscellaneous,	35 21	
Annuities,	610 00	
Interest on loan,	218 66	
Atchison assessment,	80 00	$6,555 01
Paid on loan account,		500 00
Cash on hand,		345 15
		$7,400 16

Respectfully submitted,

W. O. Chapman, *Treasurer.*

Auditor's Report.

[Indorsed on the above.]

Salem, May 16, 1896.

Your auditor respectfully reports that he has examined this day the securities herein listed and finds them to agree with the treasurer's schedule.

The treasurer's books and accounts have been examined from the date of the last annual meeting. The receipts and expenditures appear to be properly entered and the books correctly kept.

H. M. Batchelder,
Auditor.

The Local History Class.

The Local History Class, — a spontaneous organization of ladies anxious to inform themselves more exactly on many of the interesting topics in the History of the County, is now well established and enters upon its fourth year. Its system is unique and might be adopted with advantage in other bodies. Subjects are assigned to individuals or to small committees, and a written report is made, which puts the whole class in possession of all the information gathered by the investigating party. This is at once a labor-saving and an inspiring system. The work of research, which calls for time and patience, may be done by a few for the benefit of the whole. The spirit of emulation prompts each investigator to do her best in unearthing something as worthy of attention as has yet been found. So the whole field of local history is gleaned afresh. And the results have already shown how much lies undiscovered, waiting to be disclosed to the descendants of some forgotten worthy, whose kin never until now had

the leisure or inclination to look it up — and often of a quality and importance which compares well with what the livelier curiosity or superior opportunities of some other delver has long ago dug up.

The Local History Class numbers about sixty, and consists of ladies, although gentlemen are often honored with an invitation either to attend or to address its gatherings. Its organization is of the simplest. Once a year it elects a president and secretary. Its meetings occur weekly throughout the winter, and in summer include visits to different portions of the County and even exchange visits with kindred sisterhoods in other portions of the State. Twenty-five or more of these meetings have been held within the last year. Some of the papers read have shown a commendable amount of original thought and research, while others, which were mainly made up of matters already put on record, have presented familiar facts with so much novelty in method, and so contagious an enthusiasm as to give them the charm of things unknown.

The members of the Local History Class feel that they must, with the report of 1895 and '96, express their sense of the great loss sustained by them in the death of their founder and first leader, Mrs. M. M. Brooks, one of the most vitally interested members of the Essex Institute; the growth and welfare of which were very near her heart.

During her many weeks of illness she was constantly remembering her History Class, and the work they have accomplished this year is largely of her planning; as the class believed that, in fulfilling her plans, they could best show their regard for her.

Her good judgment was felt and known in many walks of life and her gracious presence was always a benediction to her friends, to whom her loss is irreparable.

Two Hundred and Seventy-fifth Anniversary of the Landing at Plymouth.

Regular meeting, Monday, December 16, 1895. The Secretary called the attention of the members present to a notice received from the Plymouth Pilgrim Society, with an invitation to this Society to be present at its celebration, December 21, 1895.

It was voted that Hon. Robert S. Rantoul and Francis H. Lee, Esq., be requested to represent the Institute at the meeting of the Pilgrim Society, December 21, 1895, and those gentlemen attended.

The President of the Pilgrim Society, at the dinner, spoke as follows: The Essex Institute of Salem responds to our invitation, not by letter, but by its representatives in person. That Institute has done a great service in preserving the history and traditions of the Puritan founders of Salem; and I have the pleasure of introducing to you its representative, Hon. Robert S. Rantoul.

Mr. Rantoul's remarks were reported as follows:

Let me thank you, sir, that in the presence of this array of older bodies, you have not omitted to extend a hand to the Essex Institute. We are a young society, — painfully young, — much younger than you, not yet counting our first half century of life; — but we are vigorous and sprightly and active and growing. We are doing good work and, like all promising children, we like to be noticed.

One may well stand abashed, Mr. President, in the presence of such a scene as this. When I recall the mighty voices to which this spot has echoed — for what great orator has our continent produced who has not, first or last, planted his feet and lifted up his voice on Plymouth Rock, — who has not found here, first or last, the Mecca

of his ambition, — the shrine of his patriotic and ancestral devotion? — when I listen, amidst the rolling of these waters, for one more trumpet tone from that matchless organ that is now silent but not forgotten in the wave-washed tomb at Marshfield, — when I recall the wonderful address made at the very outset of his career, standing on this very spot, invited by this very Society in the natal year of its existence, when, standing on the Rock of Plymouth, in 1820, two centuries complete, he uttered here that terrible denunciation of the barter in human flesh which goes ringing down the ages, now that personal weaknesses and party asperities have been long forgotten, — when I remember that unapproachable statement he made, of the interlocking, interacting relations and functions of the two sovereignties under which we Americans of to-day live and move and have our being, — a statement made in December, 1843, before the New England Society of the City of New York, and never to this hour improved upon — it is hard to believe it ever can be improved upon — I cannot but pause and hold my breath and utter a silent prayer for one more diapason-note from that most miraculous organ.

But, sir, you ask me for a word in behalf of the Essex Institute which sends me here charged with its greetings and good wishes. The relations of North and South Shore, — of Cape Cod and Cape Ann, have always been friendly and fraternal as they always should be, — never more so than in this present year of grace. We acknowledge with satisfaction, — we take pleasure to-day in reminding you of the debt, — the obligation incurred by the Massachusetts Bay Colony in the visit from your skilled and Godly practitioner, Deacon Fuller, when Governor Endecott, bitterly bereft in the loss of his courageous wife, found himself burdened with more than he could bear

in the raging epidemic of ship-fever, which scourged us during the first desolate winter of our plantation. Says Nathaniel Morton, in his *Brief Relation or New England's Memorial:* "This year sundry ships came out of *England*, and arrived at *Neumskak*, (now called Salem), where Mr. *John Endecot* had chief command, and by infection that grew amongst the Passengers at Sea, it spread also among them on shore, of which many died, some of the *Scurvey*, and others of infectious *Feavers*. Mr. *Endecot*, understanding that there was one at *Plimouth* that had skill in such Diseases, sent thither for him; at whose request he was sent unto them. And afterwards, acquaintance and Christian Love and Correspondency came on betwixt the Governour, and the said Mr. *Endecot;* which was furthered by Congratulatory Letters that passed betwixt each other; one whereof, because it *shews* the beginning of their Christian Fellowship, I shall here insert."

Now it is not my purpose to tax your patience with long-drawn recitals. This is the Pilgrims' day and theirs is the honor and glory of it. They deserve it all. Nobody — certainly no Massachusetts Bay Puritan, — would withhold a tittle of the praise they are enjoying. But may it not be, in the exuberance of joy, that the merits of old Governor Endecott and his little band of rigid old Puritans may have been permitted, for the moment, to pass a little into the shade? Let us read this letter, if you will bear with me for a moment, slowly and lovingly together. It is not long. It is Governor Endecott's letter to Governor Bradford in recognition of the great kindness described by Morton in the passage I have read. It will do us good to hear it. It will be worth the time if it do no more than call to mind the lofty strain of courtesy, — the stately, official dignity

which prevailed amongst these old-time magnates. But it will do more, unless language has lost its meaning, — unless words possess no longer a current value as the coinage of the heart. Let me read this letter of Governor Endecott's, and let us see if any better-conceived message of grateful acknowledgment, official or personal, has ever passed between these two communities before or since.

It may be true, far be it from me to deny — that our fine old Governor may have been a little hasty at times, with the emblem of popery in the King's colors, for instance; with the Anabaptists and Quakers and other schismatics and heretics; somewhat rough and rigorous at times, in correcting some little eccentricities in this neighborhood, in connection with certain May-pole proceedings, for instance; and your too practical free-trade views, in dealing in fire-arms and fire-water with that red-skinned fraternity, the Unimproved Order of Red Men. Allowing for all this I wish you would listen kindly to the old Puritan's letter, and see if you have any doubt, when you have heard it, about its being written by a gentleman. Here it is:

"To the worshipful and my right worthy friend, William Bradford, Esqr., Governor of New Plymouth, these,—

Right Worthy Sir:

It is a thing not usual, that servants to one master and of the same household should be strangers; I assure you I desire it not; nay to speak more plainly, I cannot be so to you: God's people are all marked with one and the same mark, and sealed with one and the same seal, and have for the main, one and the same heart, guided by one and the same spirit of truth; and where this is there can be no discord, nay, here must needs be sweet harmony; and the same request (with you) I make unto the Lord that we may, as Christian brethren, be united by an heavenly and

unfeigned love, bending all our hearts and forces in furthering a work beyond our strength, with reverence and fear, fastening our eyes always on Him that only is able to direct and prosper all our ways. I acknowledge myself much bound to you, for your kind love and care, in sending Mr. Fuller amongst us, and rejoice much that I am by him satisfied, touching your judgment of the outward form of God's worship; it is (as far as I can yet gather) no other than is warranted by the evidence of truth, and the same which I have professed and maintained, ever since the Lord in mercy revealed himself unto me, being far different from the common report that hath been spread of you touching that particular; but God's children must not look for less here below, and it is the great mercy of God that he strengthens them to go through with it. I shall not need at this time to be tedious unto you, for, God willing, I purpose to see your face shortly: In the meantime I humbly take my leave of you, committing you to the Lord's blessed protection, and rest.

Your assured loving friend and servant,

JOHN ENDECOT.

Naumkeak, May 11, Anno 1629."

So you see, gentlemen, that Dr. Fuller's mission bore double fruit; he relieved the North Shore colonists of a plethora of the vital fluid, but he also relieved the mind of Governor Endecott of some qualms about the heterodoxy of his Plymouth neighbors. Perhaps this last was as great a service as the other. Perhaps the deacon was no less welcome than the doctor, for our excellent Governor was no bungler in the art of physic. He could administer law, medicine or theology upon occasion. He had brought with him, as every navigator does on a voyage, a well-filled medicine chest, with its recipes and ban-

dages, and cataplasms, and with hand-books—books, says the inventory of the estate, "both of physic and chyrurgery, with one saw and six other instruments for a chyrurgeon." But when he found his outfit of science and *materia medica* unequal to the exigency, he did what any sensible professional man would have done—called in a consulting physician. If there were time, I should like to read to you from the report of the case made to Governor Bradford by that estimable "chyrurgeon and physitian," Deacon Samuel Fuller, because it shows how blood-letting and catechising travelled hand in hand, and it also shows a wholesome belief in a personal devil prevailing in this section. If you have, by any means, been led to regard the "ould deluder, Satan," as a perquisite of the Bay Colony, as a product or appanage exclusively of the North Shore, I beg you to observe that your own saintly Dr. Fuller, in his letter, from which I shall read a line, not only recognizes our old friend, the father of mischief, at sight, but even regards the North Shore potentate as a pretty fair match for the beneficent powers of the universe. Here is one of Dr. Fuller's despatches to his home government, if you will allow me to read from it, showing that theological contention at that time came as easy as blood-letting. He writes: . . . "I have been at Matapan, at the request of Mr. Warham, and let some twenty of these people blood; I had conference with them 'til I was weary. Mr. Warham holds that the visible church may consist of a mixed people, godly, and openly ungodly; upon which point we had all our conference, to which, I trust, the Lord will give a blessing. . . . We have some privy enemies in the bay, but (blessed be God) more friends; . . . oppressors there is not wanting, and Satan is busy; but, if the Lord be on our side, who can be against us? . . . Captain Endecott (my dear

friend, and a friend to us all), is a second Burrow. The Lord established him, and us all, in every good way of truth! . . .

Yours in the Lord Christ,

SAMUEL FULLER.

Massachusetts, June 28, Anno 1630."

I fear Governor Endecott was not able during his life-time to make to Plymouth any return of a favor of this magnitude, but he was only ten years in his grave when King Philip's war broke out; when that dusky strategist and statesman,—the first expounder, as I take it, of the Monroe Doctrine on this continent, began swinging the tomahawk, without discrimination, over fighters and skulkers, babes and mothers, patriarchs and preachers; letting his bludgeon fall, like the rains of heaven, alike on the just and on the unjust in this Plymouth Colony. Blazing Medfield was rolled up like a scroll, and pillage and massacre seemed to wait on what was spared by fire. If ever a struggling colony wanted help, Plymouth wanted help at that hour. Providence had favored us at that hour with a doughty champion in the person of Captain Joseph Gardner—the "Fighting Joe" of the period—who buckled on his harness, and mustered his musketeers, and marched out at the head of a gallant train-band from his home in Salem,—that home not three doors off from the present quarters of the Essex Institute,—to do and to die in effective battle for the safety of the Plymouth Colony, and there, in Narragansett Swamp, to render up a dearly valued life inside the palisado breastworks of the savage chieftain. I thank you, sir, for the opportunity of a word; and you, gentlemen, my listeners, for your courtesy and patience in permitting me to refresh your recollections on two events which should forever bind together the destinies of Eastern Massachusetts.

Lectures.

Monday Evening, January 6, 1896.— Regular Meeting in the Library room.— Three interesting papers were read by members of the Local History Class, — one by Miss Mary Ropes, on "John Horn or Orne," which called out a discussion on the Orne Family, and the other two by Miss Rosamond Symonds, on "Salem Neck and Winter Island," and on "Salem Common." It was further

Ordered, that this memorial of the last survivor of the original board of government of the Essex Institute be spread at large upon our records, and that a copy thereof be transmitted to the family of the deceased.

George Dean Phippen was born at Salem, April 13, 1815, in a homestead now numbered 20 on Hardy street. The Phippens were domiciled in Salem before Charles I made way for Cromwell to govern England and her dependencies. For the more than fourscore years of his life, Mr. Phippen has had no other residence than Salem. He died at his home on Bridge street, December 26, 1895. He was the son of Captain Hardy Phippen and of Ursula Symonds Phippen, his wife.

Captain Hardy Phippen was a clerk under our first Collector Hiller at the close of the last century, and later an Inspector of Customs in the Salem Custom House. He navigated the craft used by Dr. Bowditch in sounding and surveying Salem harbor for his famous charts, and was with the great astronomer on his early voyages while his monumental life-work, Bowditch's Navigator, was shaping itself in his mind. Captain Phippen's first voyage was sailed, 1795, in Elias Hasket Derby's famous ship "Astrea." He followed the sea for upwards of twenty years, sailing far and near for the Pickmans, Crowninshields, Derbys and Pickering Dodge. In 1808, he was mate of the brig "Nabby," when Captain Nathaniel

Hathorne, the romancer's father, in command of her on a voyage to Surinam, died in that port. Captain Phippen came home in command, and brought from Frenchman's Bay, on her next voyage, the exceptional cargo of selected lumber used in building and finishing the Woodbridge mansion at the corner of March and Bridge streets. In our second war with England Captain Phippen did service in the building of Fort Lee, and at its close, in 1815, took the news of peace to Calcutta in the Salem ship "Favorite." A sketch of him from the pen of Hon. Charles W. Upham appeared on the occasion of his death at the age of ninety in 1868. From such a father George Dean Phippen derived many of his most endearing qualities.

Mr. Phippen, after enjoying the excellent opportunities afforded by the Salem teaching of that day, took his place, on leaving school, first in the counting room of John Fiske Allen, and then, in 1838, at the age of twenty-three, connected himself as bookkeeper with the Salem Bank, then occupying rooms in Pickman Place. Twenty years later he became its cashier and remained in that position until his death, thus completing a service in a single monetary institution of fifty-seven years. Four years before entering on his life-work at the Bank, and while yet in his teens, he had taken part in an incipient movement to establish a society for the study of natural history in this county. The effort bore fruit in such an organization, formed at Topsfield in April, 1834, and Mr. Phippen was an original member of it. In 1843 he became a member of the Essex Historical Society, so that when these bodies were united in 1848 to form the present county organization, Mr. Phippen, belonging to both, was doubly a charter member of the Essex Institute. He was chosen and served for years as its first librarian; later, he was for twelve years its treasurer, and for more than twice that period

its financial guide, and lived to be the last survivor of its first board of government as well as of the original membership of the Essex County Natural History Society.

During Mr. Phippen's early years at the Salem Bank in Pickman Place, the second floor of the old banking house was variously occupied by societies in which he took an active part: the Essex Historical Society, the Salem Athenæum, the Natural History Society, the Essex Institute, in turn had chambers overhead. And besides his contributions of service to these last he acted as superintendent of the East India Marine Museum, not a stone's throw away, for the seven years succeeding 1848, at which date the activity of Dr. Wheatland, in that sphere, seems to have been transferred from the Museum to the Essex Institute just formed.

He succeeded Dr. Wheatland as superintendent of the Museum in November, 1848, and received a vote of thanks from the Marine Society on retiring in November, 1855.

Mr. Phippen was through life an ardent lover of flowers, and this passion manifested itself in many ways. Broad in his denominational views, his interest in the Tabernacle Church led him to furnish the most fitting floral decorations for his place of worship. His beautiful garden, looking out on Collins Cove, made famous through the water-colors of our artist-townsman, Turner, absorbed for years a generous portion of his time and thought. He soon came to be recognized as an authority on floriculture as he had long been on local history. The fruit and flower shows of the Institute, which were sustained with great acceptance in various halls of the city, but especially in that of the Chase Block, now superseded by the Holyoke Building, were greatly helped by Mr. Phippen's zeal, liberality and good taste.

Rarely, during the flourishing period of our field-meetings, was Mr. Phippen absent from one of these gatherings and, when present, rarely silent—being almost uniformly called on to discourse on the typical botany of the region visited. At a great field-meeting in Manchester, held August 2, 1866, at which Chief Justice Chase was present and took part, Deacon Fowler of Danvers was called on to describe the trees and Mr. Phippen the flowers of that seaside region. So admirably did they discharge this task that the Chief Justice,—himself a varied scholar of no mean attainments,—more than once expressed his wonder and delight that gentlemen so preoccupied with responsible business affairs should have reached such a mastery of these beautiful sciences as well. In this department Mr. Phippen very liberally enriched our publications with the products of his pen, contributing to the second volume of the Bulletin articles entitled, "The Plants of Scripture,"—"Dark Lane and the Wild Flowers of Salem,"—and "The Flora of Bradford."

But his interest in the Institute was not limited to the scientific side. In volumes I and IV of our Historical Collections are found papers of his, of the highest authority and value, on the original settlers of Massachusetts Bay,—the Old Planters of Cape Ann. So strongly ingrained in his nature was this fondness for the archaic that, when he had need to name a street just opened near his famous garden, and in the line of a possible development of Collins Cove as a tidal basin or water-park,—a scheme which has more than once had the endorsement of past Mayors of Salem, who have sought to remove the Almshouse with its repulsive adjuncts to another section and to throw open the Neck lands to improvement for residential uses,—Mr. Phippen selected "Planters' Street" as a

name well fitted to keep alive the memory of the pioneers and to mark the locality of Planters' Marsh where, in the day of small things, the early denizens of this historic region cut their thatch and flagging. The touching tribute paid by Mr. Phippen to his early associate and life-long coadjutor, Doctor Wheatland, at the memorial exercises reported in volume XXX of the Historical Collections, was marked by a delicacy of tone, a discrimination and insight, a fineness of phrase and a genuineness of sentiment which give it rank as a model characterization.

On the twenty-fifth anniversary of his birth, Mr. Phippen was united in marriage with Margaret, a daughter of Captain John Barton, of Salem, and she, with three sons, survives him. His seventy-fifth birthday brought with it the golden anniversary, closing a half-century of cherished companionship, and this was very generally remembered by his friends and neighbors. At the joint parade of the Second Corps of Cadets and the Salem Light Infantry, a few years since,—that auspicious hour in which the jealousies and rivalries of a century were buried out of sight, Mr. Phippen marched with three sons, shoulder to shoulder, in the Veteran Light Infantry. He joined the active corps in 1832. With no lack of manly quality, there was a fineness of fibre in Mr. Phippen's nature which no one who was brought into close relations with him could fail to recognize. His was one of those rare spirits that rise so far above the grossness of the world that to praise them seems almost an impertinence. He seemed to keep to the last all the native freshness of his early days and to refine away, as time went on, whatever dross alloys this mortal part.

In his death one more link is parted, and that a bright one, which bound together the present and the past.

Monday, Jan. 13, 1896.—The first lecture in the "free course" was delivered this evening, in Plummer Hall, by Gamaliel Bradford, Esq., of Boston, on the "Monroe Doctrine."

Mr. Bradford's views seemed to be somewhat in opposition to those of the President and a majority of the members of Congress. He was opposed to war with England under any circumstances and especially in the condition in which the country now is, although he said he was a thorough American in his feelings. But he did not believe there was anything to be gained by a war even if the "Monroe Doctrine" should be affected by British movements in Venezuela.

Monday, Jan. 20, 1896.—Regular meeting in the Library room. Mr. Gardner M. Jones, Librarian of the Salem Public Library, read a very interesting and instructive paper on "Public Libraries," describing in detail their management, their great value and their remarkable increase in number within a comparatively short period. He gave a description of the Boston Public Library, with some criticisms on its general character.

Monday, Jan. 27, 1896.—Thomas A. Mullen, Esq., of Boston, lectured this evening in Plummer Hall, on "Impressions of Europe." He gave a very interesting account of a rambling visit to various European countries, during the last summer, with many humorous observations on men and things abroad.

Monday, Feb. 3, 1896.—Regular meeting in the Library room. Miss Annie L. Warner, of Salem, gave an interesting lecture on the "Birds of Winter." She spoke of the birds noticed as coming every winter, and those that come occasionally, and of those that are with us every

month of the year. She illustrated her subject by specimens from the Peabody Academy of Science.

Monday, Feb. 10, 1896.—Prof. T. C. Mendenhall, of Worcester, lectured in Plummer Hall this evening. The subject was "Chance and the Long Run," illustrated with the blackboard and with lantern views. He spoke of what is commonly known as chance and showed how little chance there really is in it. By diagrams and figures he showed how little the accidents on railroads vary from year to year. He explained clearly how even the common events of life may seem like chance but they simply follow out a natural order of things.

Monday, Feb. 17, 1896.—Regular meeting in the Library room.

Monday, Feb. 24, 1896.—Messrs. Samuel Cabot of Boston, and Edwin Reed of Cambridge, lectured in Plummer Hall this evening. Mr. Cabot explained the cypher which it is claimed Bacon used to show that he wrote the Shakespeare plays. Mr. Reed demonstrated that the education and early training of Shakespeare and his associations and surroundings at Stratford were all against the possibility of his authorship of the works attributed to him. He believed they were written by Francis Bacon who, for political reasons, did not wish, in his time, to be known as the author.

Monday, March 2, 1896.—Regular meeting in the Library room.

Monday, March 9, 1896.—Prof. Arlo Bates, of the Institute of Technology, Boston, lectured this evening in Plummer Hall, on "Dr. Johnson and his Dictionary."

The lecturer gave a brief history of the several attempts at dictionary making before Dr. Johnson's day and then gave an account of the arrangements made by some London booksellers for the publication of Dr. Johnson's dictionary, which was begun in 1747 and finished in 1755. The work cost the Doctor £100 more than he received from the publishers so he only made a reputation by the work. Professor Bates gave a number of the amusing definitions from the first edition of the dictionary and spoke of the peculiar characteristics of Dr. Johnson in connection with this work.

Monday, March 16, 1896.—Regular meeting this evening in the Library room. On motion of Mr. Richard C. Manning, the following resolves were passed:

Resolved, that no more fitting or more lasting memorial of the virtues of the fathers can be desired than the publishing and distribution of the Records of the Continental Congress by the Government of the United States.

Resolved, that the Essex Institute earnestly desires and recommends the execution of this proposed work and respectfully urges upon our representatives in Congress the support of all proper measures looking to that end.

Mr. Gilbert L. Streeter read a portion of his paper on "Salem before the Revolution," which will appear in the Historical Collections.

Monday, March 23, 1896.—Edward Atkinson, Esq., of Boston, lectured this evening in Plummer Hall, on "The Altruistic Motive of Self Interest." The lecturer said he knew of no other word than altruism which so completely embodies the idea of that mutual service, which is the law of progress by which men are governed whether

they will or no. Resistance to the natural law of altruism is the chief cause of war and want.

Monday, March 30, 1896.—The last lecture in the course was given this evening in Plummer Hall by Rev. D. S. Clark. He gave an interesting account of his travels in Constantinople and on the Bosphorus. Illustrated with lantern views, shown by Rev. J. F. Brodie.

Monday, April 6, 1896.—Regular meeting in the Library room. Mr. Gilbert L. Streeter read the second part of his paper on "Salem before the Revolution."

On Wednesday afternoon, May 6, 1896, an address was delivered by Miss Kingsley, at Academy Hall, under the auspices of the Institute, upon Warwickshire, and the Personality and Surroundings of Shakespeare. Vice-President Rantoul filled the chair and, in presenting the distinguished lecturer, spoke substantially as follows:

On the 16th of February, 1874, the Reverend Charles Kingsley, accompanied by Miss Kingsley, his daughter, paid us the honor of a visit and began here his lecture-tour of the United States. I shall attempt no characterization of Mr. Kingsley. There is no need of that. The American Cyclopedias of Biography and the Encyclopedia Britannica unite in assigning him to the front rank in the literature of our common tongue. He was a Devonshire man, born in that beautiful southern county of England from which this Colony drew so many of its sturdy pioneers. And his ancestors bore their honorable part with the Ironsides of the south of England amongst the Puritan patriots of Cromwell's day. His mother was half American, a native of Barbadoes.

If I presume to postpone for a moment the pleasure you are anticipating, it is to say that Mr. Kingsley was

one of those visitors who come here in a friendly mood, and whose broad culture opened his mind to favorable impressions of the best this country had to offer him. Naturally we feel kindly towards those who accept us at something near our estimate of ourselves. Mr. Kingsley had for years perceived, what some of his compatriots had been unable to perceive,— that there was in America a social condition which would well reward the study of Englishmen of understanding; that this nation was not engaged in trying to make of itself a cheap and feeble copy of Great Britain, but had a conscious destiny of its own, fresh and high and admirable and noble, which for better or for worse we have been placed here, in the best part of this western continent, to work out. During the period of our Civil War and of the Reconstruction Era, Mr. Kingsley filled the important Chair of Professor of Modern History at Cambridge University, of which he had been an alumnus. He made American History the topic of his lecture course for 1862, and in announcing his purpose to do this to a friend in December, 1861, he used these words:

"As for the American question . . . I have thought of nothing else for some time. For I cannot see how I can be a Professor of past modern history without the most careful study of the history which is enacting itself around me . . . So strongly do I feel the importance of this crisis, that I mean to give, as my public lectures next October term, the History of the American States." In 1866 he was seconding the movement of a Liverpool gentleman of large views and means for the endowment at Cambridge of a Professorship of American History — a distinctly American Lectureship which was to be filled by an American selected and endorsed by the authorities of Harvard.

This extremely radical proposal, addressed to the conservatism of the mother country, naturally came to nought. But the language used by Mr. Kingsley, — still filling with distinction the Chair of Modern History at Cambridge — shows the feeling which he, in common with too few other leaders of English thought, entertained towards us at the close of our war, and I ask your indulgence in quoting from a letter of Mr. Kingsley to his friend, Sir Charles Lyell, who also knew something of us here in Salem from personal contact and observation. These are among Mr. Kingsley's words : — "When I did myself the honor of lecturing in this University on the History of the United States, I became painfully aware how little was known and how little there could be known on the subject. This great want has been since supplied by a large addition to the University Library of American literature. I think it most important that it should be still further removed by the residence among us of an American gentleman."

"Harvard University is a body so distinguished that an offer of this kind is to be looked on as a very graceful compliment."

"Of the general importance of the scheme, — of the great necessity that our young men should know as much as possible of a country destined to be the greatest in the world, I shall say little. I shall only ask, If, in the second century before the Christian era, the Romans had offered to send a lecturer to Athens that he might tell Greek gentlemen of what manner of men this new Italian power was composed, — what were their laws and customs, their intentions, their notion of their own duty and destiny, — would Athens have been wise or foolish in accepting the offer?"

These and other arguments in favor of an American

Professorship — of establishing a sort of Ambassador Extraordinary of Letters at the Court of St. James — were embodied by Mr. Kingsley in an extended address issued at Cambridge, which it was hoped might influence the authorities of the University to accept the proposal. But the movement bore no fruit.

To-day we have the great pleasure to welcome again the daughter who visited Salem with Mr. Kingsley and made the notes, since published, of his American journey. She has recorded in those notes the fact that the Old World, South of England names of places and persons which he found surviving here about Salem were to him a never failing source of interest and pleasure. She will address us to-day on Warkwickshire with something of the personality and social surroundings of Shakespeare, a timely topic, since our Baconian friends have done what they could of late, to persuade us that Shakespeare had little or no personality and no social surroundings worthy of mention. Miss Kingsley has lived in that delightful midland county — the heart of England — to which many of us are no strangers, and where the name " Shakespeare " may still be read in the simple annals on church-yard gravestones and in one instance, at least, on the door-plate of a dressmaker pursuing her art to-day.

I have the honor and very great pleasure to present Miss Kingsley.

[Miss Kingsley's address was listened to with much interest by a large and critical audience.]

An adjourned meeting of the Institute was held June 18, Vice President Rantoul in the chair. The death of our late President, the Rev. Edmund B. Willson, was referred to.

[The funeral was at the North Church on Saturday, June 16th. George H. Allen, Ezra D. Hines, Ross Turner, George M. Whipple and Alden P. White, were requested by the Executive Committee of the Institute to attend and represent the Society.]

On motion of Mr. Thomas F. Hunt it was

Voted: That a Committee of three be appointed by the Chair, of which the Chairman shall be one, — with full powers, — to take some action in regard to the death of the late President, the Rev. Edmund B. Willson.

Voted: That the thanks of the Essex Institute are due and are hereby tendered to Mrs. Sarah Goodhue King of New York City, the great granddaughter and last lineal descendant of Benjamin Goodhue of Salem, for an admirable portrait in oil, just received, of her distinguished ancestor. A native and life-long citizen of Salem, born September 20, 1748, at the Goodhue homestead, now standing near Goodhue street and numbered 70 on Boston street, Benjamin Goodhue took his degree at Harvard at the early age of eighteen and also received an honorary degree from Yale in 1804. He embarked in commerce, and at the outbreak of the Revolution became engaged in public affairs. He represented Essex County in the Senate of Massachusetts for 1784-9, when, under the new Federal constitution, he filled for three terms the seat of Congressman for this district, and with the aid of a single colleague, framed the system of revenue laws, which has proved a monument to his skill, assiduity and foresight. He became a United States senator for Massachusetts in 1796, upon the resignation of George Cabot, and acted as chairman of the Senate committee on commerce, but retired to private life four years later, and died July 28, 1814, at the mansion on Essex street now numbered 403, which he erected and occupied most of his years. The portrait, so

kindly presented to the Essex Institute, is "an excellent copy" made in New York City by William Southworth in 1895, from a likeness painted from life by J. Wright in 1790, and regarded by Mr. Goodhue and his family at that time, as a good likeness. Such a gift is an invaluable accession to the historical storehouse of Essex County, and finds its natural resting-place on the walls of the Institute.

Voted: That the above be spread at large on the records and a copy forwarded to the generous donor of the painting.

Tuesday, June 25, 1895.—A meeting of the committee to report what action should be taken on the death of the President, Rev. Edmund B. Willson, was held this day. On motion of Mr. Charles S. Osgood, it was voted that a series of resolutions be reported to the Institute at its next meeting. On motion of Mr. T. F. Hunt, it was voted that Mr. Rantoul be requested to prepare a memoir of Mr. Willson to be presented to the Institute in October next.

Regular Meeting, Monday, July 1, 1895.—The Committee chosen at a meeting of the Essex Institute held June 18, 1895, to consider and report what action it would be proper to take on the recent lamented death of President Willson, beg leave to report:—That with the exception of the case of Dr. Wheatland, which was unique, the action of the Institute upon the death of its Presidents has been substantially uniform.

Judge White died in office, April 1, 1861, after a long term of service. Resolves were passed, and Rev. Dr. G. W. Briggs was requested to prepare a memoir which was read before the Institute, January 4, 1864.

Colonel Peabody died in office after a brief service, October 31, 1867. Resolves were passed, and Hon. Charles W. Upham was requested to prepare a memoir which was read, July 18, 1868.

Ex-Mayor Huntington, an ex-President who had served four years, died September 5, 1870. Resolves were passed, and Judge Lord was invited to prepare a memoir, which he read before a meeting of the Institute, September 5, 1871.

Your committee believe that the Institute can not do better than to continue the precedent so wisely established, and they recommend that the testimonial of regret herewith submitted, be spread upon the records and transmitted to the family of the late President Willson, and that a memorial be prepared, to be presented to the Essex Institute at a meeting to be held in October next.

By the committee,

ROBERT S. RANTOUL.
THOMAS F. HUNT.
CHARLES S. OSGOOD.

RESOLVES.

Edmund B. Willson, the fifth President of the Essex Institute, died after a brief illness at his home in Salem, June 13, 1895. He was born at Petersham, August 15, 1820. He was the son of a clergyman and teacher of youth. He was a student at Yale College and at the Harvard Divinity School and received from Harvard, in 1853, the honorary degree of Master of Arts. He began his ministry at Grafton, January 3, 1844, and, after preaching there with acceptance, was called to West Roxbury as the successor of Theodore Parker, July 18, 1852. He became pastor of the North Church in Salem, June 5, 1859, and was stricken down in that pulpit at the close of his thirty-sixth anniversary service, on Sunday, June 2, 1895.

In addition to the pastoral duties to which his life was given, Mr. Willson assumed others imposed upon him by

his ardent sympathy with all worthy endeavor. Twice he yielded to the promptings of patriotism. He served as Chaplain of the 24th Regiment of Massachusetts Volunteers in its Florida and Virginia campaigns from October 1863 to July 1864. He sat in the General Court as a Representative from Salem in 1883 and 1884 and there became the champion of the broadest educational policies known to the Commonwealth,— objects as these had been of his life-long devotion,—serving the State as chairman, in his branch, of the Committee on Education. From the days of Horace Mann he has labored on the school boards of Grafton and of West Roxbury and for eight years on that of Salem, and no man knew and loved the schools of Massachusetts more thoroughly than he. Few of the charitable and correctional establishments of Salem have failed of encouragement in some form from him. A number — too many to enumerate — have recognized his aptitude and their indebtedness, by choosing him to office. Everywhere he was the welcome coadjutor in all good works. Creeds had no terrors, sectarian and party lines no restrictive potency for him. The friend of all men, he could coöperate with all. Fearless and without guile, he was a man to whom all hearts were drawn, for his words even in the most sacred experiences of life were wise and fit — a spirit fine enough for any sphere — a man whose simple presence was a benediction, whose voice and look bespoke the soul within. To the great company of pastors, revered and honored, who have illustrated our annals, from the Higginsons and Williams and Peters and Prince and Barnard and Bentley to the later times, it is permitted us to add another name as lastingly enshrined in the affections of his townsmen as those who went before.

Mr. Willson's active connection with the Essex Institute began with his ministry in Salem. We find him at an early day attending field-meetings, — occasions which

especially interested him for their novelty, — and now and again accepting the chair. From the first he has rendered enthusiastic service on important committees. He was chosen President at a special meeting in June, 1893, and then at the annual meeting in May, 1894, with the stipulation that the Institute must content itself with such attention to the office, as his many preoccupations would permit, and at the annual meeting in May, 1895, he was again elected and accepted the office in warm and well-chosen words still lingering in our ears. During these years he was the President of the Salem Athenæum and a Vice-President of the New England Historic Genealogical Society as well. What advantage was to accrue from the official influence of so rare a personality, holding so preëminent a place in public feeling and thought, was hardly to be demonstrated in the months which have intervened. The members of the Essex Institute record their loss with profound regret, and hold it to be a matter of pride that they are able, even for so short a term, to enroll amongst the incumbents of their highest office, the name of Edmund B. Willson.

Voted: That this report be spread in full upon the records and that a copy of it be transmitted with the deepest sympathy of the Essex Institute to the family of the late President.

Voted: That Vice President Rantoul be requested to prepare a memorial of Mr. Willson to be presented in October next.

Necrology of Members.

Henry Blaney, son of Benjamin and Abigail (Bowman) Blaney, was born in Boston, Jan. 3, 1822; elected a member of the Essex Institute, Nov. 16, 1891, and died in Salem, Feb. 2, 1896.

William A. Bowditch, son of Ebenezer and Mary (Appleton) Bowditch, was born in Salem, in 1809; elected a member of the Essex Institute, March 11, 1857, and died in Salem, May 15, 1896.

Hubbard Breed, son of Lucius H. and Rebecca (Story) Breed, was born in Salem, Jan. 27, 1844; elected a member of the Essex Institute, Jan. 15, 1894, and died in Salem, May 9, 1896.

Theodore Brown, son of Jonathan and Sarah C. (Hill) Brown, was born in Salem, in 1818; elected a member of the Essex Institute, Nov. 25, 1867, and died in Salem, June 8, 1895.

Mrs. Eliza D. Clement, daughter of Hazen and Serena (Dustin) Ayer, was born in Salem, in 1834; elected a member of the Essex Institute, April 15, 1895, and died in Peabody, Feb. 26, 1896.

Eustace C. Fitz, son of Jeremiah and Hannah (Eaton) Fitz, was born in Haverhill, in 1833; elected a member of the Essex Institute, Nov. 19, 1894, and died in Boston, May 27, 1895.

Mrs. Matilda B. Frye, daughter of Benjamin Brooks and widow of Major Fred Frye, was born in Bridgeport, Conn., in 1829; elected a member of the Essex Institute, June 3, 1895, and died in Bridgeport, Conn., Nov. 27, 1895.

Octavius Howe, son of Abner and Sarah (Thorndike) Howe, was born in Beverly, Jan. 22, 1815; elected a member of the Essex Institute, Aug. 19, 1863, and died in Beverly, Oct. 30, 1895.

Thomas J. Hutchinson, son of Thomas and Nancy (Bowden) Hutchinson, was born in Salem, in 1822; elected a member of the Essex Institute, March 20, 1876, and died in Salem, July 15, 1895.

Amos H. Johnson, son of Samuel and Charlotte (Howe) Johnson, was born in Boston, in 1831; elected a member of the Essex Institute, Jan. 7, 1867; Secretary for 1868, 1871, 1872; and died in Salem, May 12, 1896.

William Mack, son of Elisha and Catherine S. P. (Orne) Mack, was born in Salem, in 1814; elected a member of the Essex Hist. Society, June 30, 1841; an original member of the Institute, and died in Salem, June 9, 1895.

Edward H. Payson, son of Lemuel and Joanna (Newhall) Payson, was born in Salem, in 1804; elected a member of the Essex Institute, June 9, 1864, and died in Salem, Oct. 26, 1895.

George D. Phippen, son of Hardy and Ursula (Symonds) Phippen, was born in Salem, April 13, 1815; elected a member of the Essex County Natural History Society, in 1834, and of the Essex Historical Society, in 1843; an original member of the Institute, and died in Salem, Dec. 26, 1895.

Alexander H. Rice, son of Thomas and ——— Rice, was born in Newton Lower Falls, Aug. 30, 1818; elected a member of the Essex Institute, Aug. 20, 1894, and died in Melrose, July 22, 1895.

William G. Webb, son of Stephen aud Martha T. (Luscomb) Webb, was born in Salem, in 1833; elected a member of the Essex Institute, Nov. 7, 1870, and died in Salem, May 17, 1896.

Edward Wigglesworth, son of Edward and Henrietta M. (Goddard) Wigglesworth, was born in Boston, in 1841; elected a life member of the Essex Institute, Nov. 19, 1894, and died in Boston, Jan. 23, 1896.

Henry W. Williams, son of Willard and Elizabeth (Osgood) Williams, was born in Boston, in 1821; elected a member of the Essex Institute, Aug. 20, 1894, and died in Boston, June 13, 1895.

Edmund B. Willson, son of Luther and Sally (Bigelow) Willson, was born in Petersham, Aug. 15, 1820; elected a member of the Essex Institute, June 22, 1859, and President for the years 1893–5. He died in Salem, June 13, 1895.

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Boston City Messenger, ...	4	
Boston, Directors of Old South Work, ...		11
Boston, Industrial Aid Society for Prevention of Pauperism, ...		1
Boston, Massachusetts Charitable Mechanic Association, ...		2
Boston, Massachusetts General Hospital and McLean Hospital, ...		2
Boston, Massachusetts Historical Society, . . .	2	

Boston, Massachusetts Horticultural Society, Newspapers and Circulars,	5	96
Boston, Massachusetts Institute of Technology,		19
Boston, Massachusetts Medical Society,		2
Boston, Massachusetts State Board of Agriculture,	1	
Boston, Massachusetts State Library,	42	66
Boston, Museum of Fine Arts,		1
Boston, New England Historic Genealogical Society,		5
Boston Public Library,		5
Boston Record Commissioners,	1	
Boston Society of Natural History,		4
Boston, Washingtonian Home,		1
Bostonian Society,		1
Bowes, James L., Liverpool, Eng.,	1	
Braden, Mrs. James A.,	1	
Bradlee, Rev. C. D., Brookline, . . Circulars,		8
Braunschweig, D. Gesellschaft für Anthropologie, Ethnologie und Urgeschicte,		2
Bremen, Naturwissenschaftlicher Verein,		4
Bridgeport, Ct., Fairfield County Historical Society,	1	
Bridges, Henry G., London, Eng., Newspapers,		1
Brigg, William, Harpenden, Herts, Eng.,		12
Brigham, Mrs. Lincoln F.,		1
Brighton and Sussex Natural History and Philosophical Society,		1
Brisbane, Queensland Branch of Royal Geographical Society of Australia,		1
Brooklyn (N. Y.) Library,		1
Brooklyn, N. Y., New England Society,		1
Brooks, Henry M., ... Newspapers,	13	52
Brooks, Mrs. Henry M., . . . Newspapers.		
Brooks, Jenny,		8
Brown, Abram E., Bedford,	2	
Brown, Frances,	210	60
Brownell, T. Frank, New York, N. Y.,		1
Brünn, Naturforschender Verein,		2
Brunswick, Me., Bowdoin College,		1
Bruxelles, Académie Royale des Sciences, Belles-Lettres et Beaux-Arts,		14
Bruxelles, Société Belge de Microscopie,		6
Bruxelles, Société Royale de Botanique,		2
Bruxelles, Société Royale des Sciences de Liége,		1
Bruxelles, Société Royale Malacologique,		34
Bryant, David M., South Deerfield,		2

Buenos Aires, Sociedad Cientifica Argentina, . .		12
Buffalo (N. Y.) Historical Society, ...		1
Buffalo (N. Y.) Library, ...		2
Burlington, University of Vermont, ...		2
Burton, C. M., Detroit, Mich., ...		2
Caen, Académie Nationale des Sciences, Arts et Belles-Lettres, ...		1
Calcutta, Geological Survey of India, . . .		4
Calcutta, Indian Museum, ...		3
Cambridge, Harvard University, ...		3
Cambridge, Museum of Comparative Zoology, . .		11
Cambridge, Peabody Museum of Archæology and Ethnology, ...		2
Cambridge Philosophical Society, ...		2
Campbell, Mrs. Mary F., Plymouth, ...		2
Carroll, Thomas, Peabody, ...		1
Cedar Rapids, Iowa, Masonic Library, . . .		1
Chadwick, James R., Boston, ...		1
Chapel Hill, N. C., Elisha Mitchell Scientific Society,		2
Chase, Charlotte F., ...		9
Chase, Henry A., ...		2
Cherbourg, Société Nationale des Sciences Naturelles et Mathematiques, ...		1
Chicago (Ill.) Academy of Sciences, ...	1	15
Chicago, Ill., Civic Federation of, ...		1
Chicago, Ill., Field Columbian Museum, . . .		8
Chicago (Ill.) Historical Society, ...		1
Chicago, Ill., Library Bureau, ...		1
Chicago, Ill., Newberry Library, ...		1
Chicago (Ill.) Public Library, ...		1
Chicago, Ill., University of, ...		8
Choate, Isaac B., Boston, ...	1	
Choate, John H., ...		60
Christiania, Norwegische Commission der Europäischen Gradmessung, ...		3
Christiania, Videnskabs-Selskabet, ...		54
Cilley, J. P., Rockland, Me., ...		5
Cincinnati, Historical and Philosophical Society of Ohio, ...		1
Cincinnati (O.) Public Library, ...		2
Cincinnati (O) Society of Natural History, . .		1
Clark, J. M., Toronto, Can., ...		1
Cleveland (O.) Public Library, ...		3
Cleveland, O., Western Reserve Historical Society,		2

Cogswell, William, Estate of, ...	577	
Cole, George W., Jersey City, N. J., ...		1
College Hill, Tufts College, ...		3
Columbus, O., Archæologist Publishing Company, .		4
Columbus, Ohio State Board of Agriculture, . .		11
Comstock, Frank M., Cleveland, O., ...		1
Conant, W. P., ...	1	27
Concord, New Hampshire Historical Society, . .	33	1
Copenhagne, Société Royale des Antiquaires du Nord,		2
Cox, Francis, ...		48
Cutter, Abram E., Boston, ...		1
Danforth, Mrs. John, Lynnfield, ...		13
Danvers, Peabody Institute, ...		1
Danvers, Town of, ...	1	
Davis, Andrew Mc F., Cambridge, ...		2
Dayton, W. Hardy, ...		1
Dean, Annie A., ...	3	
De Costa, B. F., New York, N. Y., ...		1
Dedham Historical Society, ... , . .		4
Dedham Town Clerk, ...		1
Dennis, Edwin W., ...	17	
Dennis, Louise D., ...		6
Denny, Henry G., Boston, ...		1
Derby, Perley, ...	1	
Des Moines, Historical Department of Iowa, . .		3
Des Moines, Iowa Academy of Sciences, . . .	1	
Des Moines, Iowa Geological Survey, ...	1	
Detroit (Mich.) Public Library, ...		1
Dow, Geo. Frs.. Topsfield, ...	2	
Dresden, Naturwissenschaftliche Gesellschaft "Isis,"		2
Dresden, Verein für Erdkunde, ...		2
Driver, Mrs. Stephen P., ...	1	
Drummond, Josiah H., Portland, Me., . . .		1
Dublin. Royal Irish Academy, ...		5
Durkheim, Pollichia Naturwissenschaftlicher Verein der Rheinpfalz, ...		4
Eaton, John D., San Francisco, Cal., . Newspapers.		
Edes, Henry H., Charlestown, . . Circulars,		11
Emden, Naturforschende Gesellschaft, ...		1
Erlangen, Physikalisch-Medicinische Gesellschaft, .		1
Essex Town Clerk, ...		24
Evans, Forrest L., ...	1	
Everett, William, Quincy, ...	1	
Exeter, N. H., Phillips Exeter Academy, . . .		1

Fabens, Caroline A.,	4	
Falmouth, Royal Cornwall Polytechnic Society,		1
Felt, John,		1
Fields, Osgood, London, Eng.,	1	
Firenze, Biblioteca Nazionale Centrale,		24
Firenze, Societa Entomologica Italiana,		1
Fiske, Mrs. Sarah D., Malden,	1	104
Fowler, Harriet P., Danvers,	5	
Frankfurt-a-M Senckenbergische Naturforschende Gesellschaft,		5
Frear, William, State College, Pa.,		1
Freibourg, Naturforschende Gesellschaft,		3
Fribourg, Société Fribourgeoise des Sciences Naturelles,		1
Frye, Mrs. Nathan A., ... Newspapers,	13	
Gardner, Elizabeth B ,		1
Gardner, Mrs. Henry,	107	47
Geer, Rev. C. M., Danvers,		1
Genève, Institut National Genevois,		1
Genève, Société de Physique et d'Histoire Naturelle,		1
George, Elijah, Suffolk County Register of Probate,	3	
Giessen, Oberhessische Gesellschaft für Natur und Heilkunde,		1
Gillis, James A., Winchendon, . . Newspapers,		6
Gilman, Misses and Mrs. G.W. Lane, Norwich Town, Ct.		1
Glasgow, Baillies' Institution,		1
Glasgow Natural History Society,		1
Goldthwaite, Mrs. E. H.,	10	13
Goodell, Abner C., Jr.,	12	3
Gottingen, K. Gesellschaft der Wissenschaften,		8
Gould, John M., Portland, Me.,		2
Gove, William H.,	52	
Grand Rapids (Mich.) Public School Library,		1
Granville, O., Denison Scientific Association,		1
Graves, Mrs. Catherine M., Portland, Ct.,	2	
Graves, John C., Buffalo, N. Y.,	1	
Green, Charles R., Lyndon, Kan., . . Circulars.		
Green, Samuel A., Boston,	2	31
Greenwood, Isaac J., New York, N. Y.,		3
Groveland Town Clerk,		2
Halifax, Nova Scotian Institute,		1
Halle, K. L.-C. Deutsche Akademie der Naturforscher,		2
Halle, Naturwissenschaftlicher Verein für Sachsen und Thüringen,		2

Hamburg, Naturwissenschaftlicher Verein, . .		2
Hamilton Town Clerk, ...		1
Hamlin, Augustus C., Bangor, Me., ...	1	
Hannover, Deutscher Seefischereiverein, . . .		95
Hardy, Mrs. Mary C., Farmington, Ct., . . .		5
Harlem, Musée Teyler, ...		1
Harlem, Société Hollandaise des Sciences, . . .		3
Harrisburg, Pennsylvania State Library, . . .	25	1
Hartford, Connecticut Historical Society, . . .		1
Hartford, Connecticut Quarterly Company, . .		2
Hartford, Ct., School of Sociology, ...		2
Hartford, Ct., Trinity College, ...		2
Hassam, Frederick F., Hyde Park, Mass., . . .		1
Hassam, John T., Boston, ...	1	2
Haverhill City Clerk, ...		3
Hazen, Rev. Henry A., Boston, ...	1	
Helena (Mont.) Public Library, ...		4
Herrick, C. L., Granville, O., ...		3
Heywood, Rev. J. H., Louisville, Ky., ...		1
Hoadley, Charles J., Hartford, Ct., ...	1	
Hoar, George F., Worcester, ...		1
Hotchkiss, Susan V., New Haven, Ct., Newspapers.		
Houghton, Michigan Mining School, ...		2
Hunt, T. F., ...	19	71
Iowa City, Iowa State Historical Society, . . .		8
Iowa City, Laboratories of Natural History of State University of Iowa, ...		1
Ipswich Town Clerk		3
Irving Company, New York, N. Y., ...	1	
Ithaca, N. Y., Cornell University, ...		3
Jenkins, Lawrence W., Boston, ...		26
Jersey City (N. J.) Free Public Library, . . .		11
Johnson, Thomas H., ...		1
Jones, Gardner M., ...	1	26
Kassel, Verein für Naturkunde, ...		1
Kimball, Elizabeth H., ...	53	10
King, Horatio C., Brooklyn, N. Y., ...		1
Kjöbenhavn, Botanisk Tidskrift, ...		1
Kjöbenhavn, Nordisk Oldkyndighed og Historie, .		4
Kjöbenhavn, K. D. Videnskab-Selskabs, . . .		8
Knowlton, George K , Hamilton, ...		1
Königsberg, Altertums-gesellschaft Prussia, . .		1
Königsberg, Physikalisch-Okonomische Gesellschaft,		1
Lamson, Frederick, ... Newspapers,		2

Lander, Helen D.,		1
Lansing, Michigan State Library,	2	
Latimer, Rev. George D.,		1
Lausanne, Société Vaudoise des Sciences Naturelles.		2
Lawrence, Kansas University,		4
Lawrence Free Public Library,		1
Lee, Francis H., Newspapers, Circulars and Music,	61	314
Leeds Philosophical and Literary Society,		1
Leiden, Rijks-Universiteit,		3
Leipzig, K. S. Gesellschaft der Wissenschaften,		6
Leipzig, Naturforschende Gesellschaft,		1
Le Mans, Société d' Agriculture, Sciences et Arts.		2
Lincoln, Nebraska State Historical Society,		2
Linehan, Thomas J.,	1	
Little, George T., Brunswick, Me.,		1
Liverpool Literary and Philosophical Society,	6	
London, Geological Society,		5
London, Royal Geographical Society,		12
London, Royal Society,		13
London, Zoölogical Society of,		4
London, Entomological Society of Ontario,		13
Loring, Charles G., Boston,	8	
Lund, Kongliga Universitet,		2
Lüneburg, Naturwissenschaftlicher Verein,		1
Luxembourg, L' Institut Grand-Ducal,		1
Lyon, Société d' Agriculture, Science et Industrie,		3
Lyon, Société Linnéenne,		1
Madison, N. J., Drew Theological Seminary,	2	39
Madison, Wisconsin Academy of Sciences, Arts and Letters,		1
Madison, Wisconsin State Historical Society,	1	2
Madrid, Observatorio de,	1	
Madrid, Sociedad Española de Historia Natural,		3
Manchester Literary and Philosophical Society,		5
Manchester Museum, Owens College,	1	3
Manchester, N. H., City Library,		2
Manchester Town Clerk,	1	10
Manning, Richard C., ... Newspapers.		
Manning, Robert, . Newspapers and Circulars,		19
Mansfield, Helen, Gloucester,		1
Marsh, Lucius B., Boston,	1	
Massachusetts Commissioner of Public Records,		1
Massachusetts, Secretary of the Commonwealth of,	24	
Massachusetts State Board of Health,	1	50

Melville, Henry, New York, N. Y., ...	1	
Meriden (Ct.) Scientific Association, ...		1
Merriam, Horatio C., ...	5	
Merriam, Otis, Chelsea, ...	20	
Michigan Agricultural College, ...		13
Milwaukee (Wis.) Public Museum, ...		1
Minneapolis, Geological and Natural History Survey of Minnesota, ...		5
Minneapolis (Minn.) Public Library, ...		1
Minnesota Weather Service, Minneapolis, . . .		10
Montpelier, Vermont State Library, ...	104	26
More, Clarence B., Philadelphia, Pa., ...	1	
Morehouse, C. S., New Haven, Ct., ...	1	
Morse, Edward S., . Newspapers and Circulars,	7	279
Moscou, Société Imperiale des Naturalistes, . .		4
München, D. Gesellschaft für Anthropologie. Ethnologie und Urgeschichte, ...		8
München, K. B. Akademie der Wissenschaften, . .		8
Münster, W. Provinzial Verein für Wissenschaft und Kunst, ...		2
Muzzey, David P., Cambridgeport, ...	7	
Napoli, R. Accademia delle Scienze Fisiche e Matematische, ...		10
Nashville, Tennessee Historical Society, . . .		2
Nashville, Tennessee State Board of Health, . .		11
Needham, Mrs. Daniel, Groton, ...		1
Nevins, W. S., ...	24	79
New Brighton, Natural Science Association of Staten Island, N. Y., ...		9
New Haven, Connecticut Academy of Arts and Sciences, ...		1
New Haven, Ct., Yale University, ...		5
New Orleans, La., Tulane University, ...		1
New York (N. Y.) Academy of Sciences, . . .		2
New York, N. Y., American Geographical Society, .		4
New York, N. Y., American Museum of Natural History, ...		11
New York (N. Y.) Chamber of Commerce, ...	1	
New York (N. Y.) Genealogical and Biographical Society, ...	1	4
New York (N. Y.) Historical Society, ...		1
New York (N. Y.) Mercantile Library, ...		1
New York, N. Y., Metropolitan Museum of Art, . .		1
New York (N. Y.) Microscopical Society, ...		3

Nichols, Andrew, Jr., Bridgewater, N. H., . . .		1
Nichols, James B., ...	1	
Northampton, Smith College, ...		1
North Andover Town Clerk, ...		1
Northend, Wm. D., ...	1	1
Nourse, Dorcas C., ... Newspapers.		
Nurnberg, Naturhistorische Gesellschaft, . . .		1
Oberlin (O.) College, ...		1
Oliver, Mrs. Grace A., ... Newspapers,	1	11
Osborne, Mrs. George F., Peabody, ...	25	2
Osgood, Charles S., ...	124	40
Ottawa, Can., Office of Minister of Justice, . .		8
Ottawa, Geological Survey of Canada, . . Maps,		1
Ottawa, Royal Society of Canada, ...		2
Painter, Mrs. Byron H., Alleghany, Pa., . . .	1	
Palermo, R. Accademia di Scienze, Lettre e Belle Arti,		5
Palo Alto, Cal., Leland Stanford Junior University, .		2
Paris, Museum d' Histoire Naturelle, ...		5
Paris, Société d' Anthropologie, ...		11
Paris, Société des Etudes Historiques, ...		1
Paris, Société Entomologique de France, . . .		20
Paris, Société Nationale d'Acclimatation, . . .		9
Paris, Société Zoologique de France, ...		9
Parsons, Ebenezer, Lynnfield, ...		5
Payson, Edward H., ...	10	185
Peabody, George L., ... Newspapers,	5	3
Peabody, Peabody Institute, ...	1	1
Peet, Rev. S. D., Good Hope, Ill., ...		6
Pell, Howland, New York, N. Y., ...	1	
Perkins, Mary E., Norwich, Ct., ...	1	
Perley, M. V. B., Ipswich, ...		2
Perley, Sidney, ... Newspapers.		
Philadelphia, Pa., Academy of Natural Sciences, . .		3
Philadelphia, Pa., American Catholic Historical Society, ...		6
Philadelphia, Pa., American Philosophical Society, .		3
Philadelphia, Pa., City Institute, ...		1
Philadelphia, Historical Society of Pennsylvania, .		4
Philadelphia, Pa., Indian Rights Association, . .		7
Philadelphia (Pa.) Library Company, ...		1
Philadelphia, University of Pennsylvania, . . .		2
Philadelphia, Pa., Wagner Free Institute of Science, .		1
Philadelphia, Pa., Zoological Society of, . . .		2
Philbric, Mrs. Jennie E., ...	46	62

Philbrick, Eliza and Helen,	Newspapers,		20
Phillips, Stephen H.,	Newspapers.		
Phippen, Joshua B.,	Newspapers,		20
Pickering, John,		4	15
Pierson, Frederick L., Ellsworth, Ct.,			1
Pond, Mrs. Nathan G., Milford, Ct.,			1
Pool, Wellington, Wenham,			1
Port of Spain, Victoria Institute of Trinidad,			1
Portland, Maine Genealogical Society,			1
Portland, Maine Historical Society,			5
Portland (Me.) Society of Natural History,			1
Portland, Ore., Library Association of,			8
Prag, K. K. Sternwarte,			1
Pray, John H., Sons and Company, Boston,			1
Preston, Levi, Peabody,			13
Prince, Rev. John, Essex,			1
Princeton, N. J., Princeton College,			5
Providence, R. I., American Humanitarian League,			2
Providence, R. I., Brown University,			1
Providence, Rhode Island Historical Society,			4
Providence, R. I., Narragansett Historical Publishing Company,		2	
Providence (R. I.) Public Library,			11
Providence (R. I.) Record Commissioners,		2	
Providence, R. I., Westminster Congregational Society,			1
Putnam, Eben,		14	397
Quebec, Can., L'Université Laval,			1
Rantoul, Robert S.,		1	5
Rea, C. E., Danvers,			1
Reed, Edwin, Andover,		1	
Regensburg, K. B., Botanische Gesellschaft,			1
Richmond, Virginia Historical Society,			4
Riga, Naturforschende Verein,			2
Ripley, Charles S., U. S. Navy,		1	
Rochester (N. Y.) Academy of Science,			1
Rochester, N. Y., Reynolds Library,			1
Ropes, Mrs. Charles A.,		57	74
Rowell, E. T., Lowell,		1	
Ruggles, H. Stoddard, Wakefield,		2	
St. John, Natural History Society of New Brunswick,			1
St. Louis (Mo.) Academy of Science,			6
St. Louis (Mo.) Mercantile Library Association,			2
St. Louis, Missouri Geological Survey,		5	
St Pétersbourg, Jardin Imperial de Botanique,			2
St. Pétersbourg, L'Academie Imperiale des Sciences,			9

St. Pétersbourg, Société Entomologique de Russie,		1
St. Thomas, Ont., Elgin Historical and Scientific Institute,	1	
Salem Associated Charities,		1
Salem City Clerk,	1	
Salem Evening News,	2	6
Salem Five Cents Savings Bank,	13	332
Salem, Peabody Academy of Science,	61	177
Salem Public Library,		15
Salem Water Board,		1
Salem Young Men's Christian Association,		5
Salisbury Town Clerk,		10
San Diego, Cal., West American Scientist,		16
San Francisco, California Academy of Sciences,		5
San Francisco (Cal.) Board of Supervisors,	1	
San Francisco (Cal.) Free Public Library,		1
San Francisco, California State Mining Bureau,		1
Santiago, Société Scientifique du Chili,		1
Saugus Town Clerk,		1
Saunders, Mary T.,	2	1
Savory, Tristram T.,	1	
Sears, John H.,		1
Siam, King of, Bangkok,	19	
Siena, Rivista Italiani di Scienze Naturali,		2
Silsbee, Mrs. William, ... Newspapers.		
Simes, Mrs. Mary E., ... Newspapers,	47	134
Smith, A. A., ... Newspapers.		
South Boston, Perkins Institution and Massachusetts School for the Blind,		1
Speed, Thomas, Louisville, Ky.,	1	
Spofford, Charles B., Claremont, N. H.,		1
Springfield City Library Association,		1
Springfield, Illinois Bureau of Labor Statistics,	1	
Springfield, Illinois State Board of Agriculture,		1
Stanwood, James Rindge, Portsmouth, N. H.,		1
Stavanger Museum,		1
Stettin, Entomologischer Verein,		1
Stickney, G. A. D., ... Newspapers,	24	21
Stockholm, Academie Royale des Sciences,	1	3
Stockholm, Entomologiska Föreningen,		3
Stone, Frederick D., Philadelphia, Pa.,		1
Streeter, Gilbert L.,		7
Sydney, Linnean Society of New South Wales,		2
Sydney, Royal Society of New South Wales,		2
Syracuse (N. Y.) Central Library,		1

Taft, Russell S., Burlington, Vt., ...		1
Taunton, Somersetshire Archæological and Natural History Society, ...		1
Taunton, Old Colony Historical Society, . . .		1
The Babcock and Wilcox Company, New York, N. Y.,	2	
The Hague, Nederlandsche Entomologische Vereenig-ing, ...		4
The Securities Company, Philadelphia, Pa., . . .	1	
Throndhjen, K. Norske Videnskabs-Selskabet, . .		1
Tilton, John P., ...		6
Todd, William C., Atkinson, N. H., ...		1
Tokio, Imperial University, ...		1
Topeka, Kansas State Historical Society, . . .		2
Toronto, Canadian Institute, ...		2
Trenton, New Jersey State Library, ...	2	
Tromso Museum, ...		2
Turner, David, ...	1	
Turner, Ross, ...	45	61
U. S. Bureau of Education, ...	2	1
U. S. Bureau of Ethnology, ...		3
U. S. Bureau of Statistics of Labor, ...	2	
U. S. Chief of Engineers, ...	7	
U. S. Chief of Ordnance, ...	1	
U. S. Civil Service Commission, ...	1	
U. S. Coast and Geodetic Survey, ...	1	1
U. S. Commission, Columbian Historical Exposition, .		10
U. S. Commissioner of Education, ...	2	
U. S. Department of Agriculture, ...	3	127
U. S. Department of Interior, ...	38	29
U. S. Department of Labor, ...		3
U. S. Department of State, ...	1	12
U. S. Fish Commission, ...	1	1
U. S. Geological Survey, ...	4	25
U. S. Life-Saving Service, ...	1	
U. S. National Museum, ...	2	5
U. S. Patent Office, ...		55
U. S. Quartermaster-General, ...	1	
U. S. Superintendent of Documents, ...	140	21
U. S. Surgeon-General, ...	2	
U. S. Treasury Department, ...	1	3
U. S. War Department, ...	4	1
U. S. Weather Bureau, ...		4
Upsal, K. Vetenskaps-Societeten, ...		1
Urbanna, Illinois State Museum of Natural History, .		2
Waldo, Phœbe M., ...	3	

Waring, George E., New York, N. Y., . . .		2
Warren, Theodore, Warren, R. I., ...		1
Washington, D. C., Society of Naval Architects, .		1
Washington, D. C., Anthropological Society, . .		7
Washington, D. C., Microscopical Publishing Company,		11
Washington, D. C., Smithsonian Institution, . .		6
Waters, Mrs. C. E. C., Boston, ...	7	231
Waters, Henry F., London, Eng., . Newspapers.		
Waters, Rev. T. F., Ipswich, ...		2
Waterville, Me., Colby University, ...		3
Watkins, W. K., Boston, ...	1	2
Watson, S. M , Portland, Me., ...		3
Welch, William L., . Newspapers and Circulars,		100
Wellesley, Wellesley College, ...		1
Wellman, Thomas B., Lynnfield, ...	1	5
West Newbury Town Clerk, ...		4
Wheatland, Elizabeth, ... Newspapers,	2	22
Wheelwright, Edmund M., ...		1
Whipple, George M., ... Newspapers,		20
Wien, K. Akademie der Wissenschaften, . . .	1	12
Wien, K. K. Geologische Reichsanstalt, . . .		15
Wien, K. K. Naturhistorische Hofmuseums, . .		1
Wien, K. K. Zoologisch-botanisch Gesellschaft, .		9
Wien, Verein zur Verbreitung, ...		1
Wiesbaden, Nassauischer, Verein für Naturkunde, .		1
Wilkes-Barré, Pa., Wyoming Commemorative Association, ...		1
Williams, Harriet M., Salem, N. Y., ...	1	
Williams, John S., ...	15	129
Williamsburg, Va., College of William and Mary, .		6
Willson, Rev. E. B., Estate of, . . Newspapers,	69	11
Winsor, Justin, ...		39
Winthrop, Robert C., Jr., Boston, ...	2	
Woman's Journal Publishers, Boston, . Newspapers,		
Woodbury, Louis A., Groveland, ...	1	1
Woods, Mrs. Kate T., ... Newspapers,		120
Woodward, P. H., Hartford, Ct., ...	1	
Worcester, American Antiquarian Society, . .		4
Worcester Society of Antiquity, ...		1
Wright, Frank V., Hamilton, . . Circulars,	1	139
Wurzburg, Physikalisch-Medicinische Gesellschaft, .		15
Yonkers (N. Y.) Historical and Library Association,		1
Youmans, Dr. W. J., New York, N. Y., . . .		189
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BULLETIN

OF THE

ESSEX INSTITUTE.

Vol. 28. Salem: July — December, 1896. Nos. 7–12.

THE PHOTOGRAPH AND SKELETON OF A NATIVE AUSTRALIAN.

BY GEORGE A. DORSEY, PH.D.,

Acting Curator, Field Columbian Museum.

In March, 1891, the Peabody Museum received by purchase from Mr. A. P. Goodwin a large collection of ethnological objects from Oceania. Among these were the photograph and skeleton of a native of Lismore, who was known as Neddy Larkin. As a perfect skeleton and photograph of an Australian subject in life are not often met with in the museums of this country, Professor Putnam, the Curator of the Museum, placed the skeleton and photograph in my hands for study. Mr. Goodwin's letter, in which he states that he knew Neddy Larkin, saw him buried, and personally secured his skeleton, is on file in the Museum. Thus there can be no doubt that the skeleton is really that of the individual of the photograph.

Lismore is on the Richmond river in the extreme northeastern part of New South Wales. According to an ethnographical map of Fraser, this region of New South Wales is inhabited by the Paikalyug tribe.

PHOTOGRAPH.

Judging from the photograph and skeleton, Neddy Larkin must have been about fifty years old. There is nothing especially noteworthy brought out by the photograph. It presents to us simply a typical specimen of a native of New South Wales. The beard apparently is slightly gray, and evidently has been trimmed quite short. The hair is long and in the usual state of disorder, but seems rather straighter than one usually finds in a native of Australia. The deep set eyes and overhanging brows are quite prominent, and give some indication of the massive superciliary ridges which we find on the skull. The nose is very broad but not flat, and is well shaped. A depression between the lower lateral cartilages of the nose is well marked and has almost the appearance of a slit in the nose. The body is not so lean as is usually the case with Australians, judging from several photographs before me. The arms are covered with long, thick hair, and hair can be seen thickly scattered over a small area high up the breast. The body below the waist is not visible. In the left hand is held a rough boomerang. On the upper left arm (the upper right arm is hid by the fore-arm) and on the breast are plainly seen the usual marks of adornment — long straight brands or scars. They run entirely across the breast at close intervals, the highest one being placed just above the mammæ. At least seventeen lines are visible and there may be more which can not be seen. On the arm thirteen scars or "mom-bari" are visible; they run lengthwise and are about eight

inches in length. The primary significance of this peculiar form of tattooing is not known and has been forgotten even by the natives themselves. Concerning the method of operation, Frazer says "the brand is cut with a piece of flint or of a glass bottle in some simple pattern; the cuts bleed a good deal, and to make them deeper the knife is applied again and again. While the wounds are still open, hoar frost is rubbed in, or charcoal, and that causes well-marked ridges to remain permanently there. The thing is done when the person is young, perhaps from 6 to 12 years of age."

The anterior edges of the sterno-cleido-mastoid muscles are unusually prominent and make a well-defined depression between them.

SKELETON.

The skeleton is almost complete, only a few of the terminal phalanges being missing. The extremities of both hands and feet have a charred appearance as if from having been in fire. Otherwise the skeleton is in good condition. The length of the entire skeleton is 1616 mm. which with 35 mm. for the soft parts would make 1651 mm. for the stature of Neddy Larkin. In taking the height of the skeleton I followed the method employed by Dr. Dwight and fully described by him in the Medical Record of Sept. 8, 1894.

Examining the length of the long bones we have the following measurements:

Humerus	272 mm.
Radius	253
Ulna	272
Femur, oblique length	440
Tibia, maximum length	381

From these measurements some interesting observations can be made. The proportion of the humerus to the total

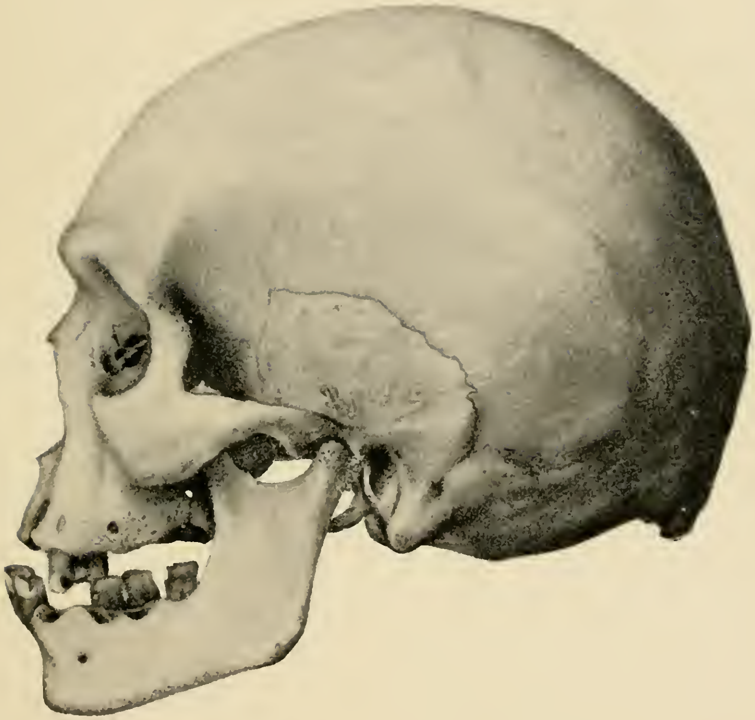
length of the skeleton is 20.3 which is even greater than that given by Humphrey for Bushmen. The relation of the radius to the stature is 15.6 which is approximately the figure given by Hovelacque and Hervé. The relations of the femur and tibia to the skeleton are 26.8 and 23.2 respectively. The antibrachial index is 80.3 which is very high, and approximates that of the higher apes more closely than does the same index in the African negro.

The torsion of the humerus is 136 degrees. According to Hovelacque and Hervé, the degree of torsion of the humerus in the human family is lowest among the Australians.

SKULL.

The skull is remarkable in many ways. The general surface is very smooth and it is almost impossible to make out any muscular ridges. In addition to the sutures which are normally closed in an individual of this age, the following are more or less completely synostosed: the coronal, sagittal, lambdoidal, spheno-frontal, spheno-parietal, malo-zygomatic, malo-frontal, nasal, naso-maxillary, intermaxillary, palato-maxillary and interpalatal. The original degree of serration of the cranial sutures cannot be determined.

Norma lateralis. — There is a considerable amount of alveolar prognathism, rather more than one usually finds in an Australian skull. The teeth are nearly horizontal. The nasal spine is heavy and prominent, a character not usually associated with the lower types of crania. The nasal bones are not prominent. The glabella, while very highly developed, is entirely obscured by the enormous development of the superciliary ridges. The inion is equally massive and projects downwards so that it supports the posterior region of the skull. The mastoid processes are not prominent. The temporal ridges can



no longer be distinguished. A faint spheno-parietal suture can be made out about 4 mm. in length, which gives the so-called pterion in H. The curvature of the vault of the cranium is very gradual, the curve of the frontal region passing imperceptibly into that of the parietal; in type it approaches the Neanderthal. The external auditory meatus is unusually large and is elliptical in shape.

Norma verticalis.— With the skull in this position its extreme length and the narrowness of the frontal region are very striking, while the prominence of the supra-orbital ridges is equalled by that of the external angular processes of the frontal bone. The parietal eminences are small but well marked. There is nothing which approaches the parietal crest which often marks skulls of an inferior type. The parietal foramina have entirely disappeared.

Norma frontalis. — From a front view the face seems all orbits and nose, so great are their cavities. The orbits are especially profound and large. The angle of inclination of the transverse diameter seems unusually great. The lachrymal bones are obscured by the frontal process of the maxillary bones and none of the lachrymal sutures can be determined. The infra-orbital groove continues broad and shallow, almost to the orbital crest. On the right orbit is a supra-orbital foramen, on the left side a shallow notch is hardly recognizable. The nasal bones broaden and flatten out very much at their inferior border. The inferior border of the nasal cavity is not sharp as it usually is in Europeans, but is concave so that the nasal cavity is not well defined and passes gradually on to the alveolar region. The maxillary bones are broad, especially through the alveolar region. The canine fossæ are extremely shallow, a character the reverse of the European type.

Norma posterior.—The skull is hypsicephalic or nar row and high, but not to an extreme degree as is usually the case with Australian skulls. The region just above the occiput and below the parietal eminences is slightly flattened. The transition of the posterior region is very marked at the region of the inion where the occipital bone passes forward very abruptly.

Norma inferior.— While the external occipital crest is fairly prominent, no trace of the inferior curved line can be made out. The digastric and occipital grooves are very deep and pronounced and the foramen ovale seems to be of unusually large size. The zygomatic arches stand out prominently and the prognathism already spoken of is seen in the distinct forward slant of the alveolar process. The surfaces of the alveolar process are broad and are more or less absorbed, especially in the regions of the incisors.

From a morphological consideration of the skull we pass to the craniometric characters. The following measurements were taken :

Capacity	1290 cc.
Maximum length	191 mm.
Maximum breadth	131
Height, basion-bregna	140
Index, length-breadth	69
Index, length-height	73
Minimum breadth of forehead	98
Breadth of base	102
Height of face, nasal point-alveolar point (A)	71
Height of face, nasal point, mental point (B)	118
Breadth of face, bi-zygomatic diameter	131
Index face (A)	54
Index face (B)	90
Height of nose	50

Breadth of nose	32 mm.
Index of nose	64
Height of orbit	38
Breadth of orbit	44
Index of orbit	86
Length of palate	52
Breadth of palate, between lateral canines (A)	32
Breadth of palate, between 2nd molars (B)	43
Index of palate (A)	61
Index of palate (B)	82
Mandibular angle	124
Basi-alveolar length	100
Basi-nasal length	97
Index of alveolar gnathism	103.9

The capacity, 1290 cc., is somewhat higher than that usually given for Australians, Turner giving 1230 cc. and Quatrefages and Hamy, 1269 mm. The cephalic index of 69 proves the skull to be longer than the average, Quatrefages and Hamy, and Broca giving 71. The vertical index is about the average for Australians.

Both facial indices indicate a short, broad face, a characteristic trait of Australians. The nasal index of 64 is unusually high, the average among the Bushmen being only 60, while the average for the Australians is 57. The orbital index also is unusually high, 80 being the average. The two palatal indices show the palate to be of a very low type, the posterior diameter being proportionally much greater than the anterior. The other measurements do not merit special comment. To conclude with the skull, it is notable for its amount of synostosis, small capacity, pronounced dolicocephalism, mesoseme orbits, platyrhine nose, broad palate, and prognathism.

Teeth.— The incisors, right canine, both 3rd molars, and the left second molar of the upper teeth, and the first and second premolars and all the molars of the left side

of the lower teeth were lost during life and the alveoli are considerably absorbed. Of the upper teeth there now remain only the premolars of the right side and the canine and first premolar of the left side ; of the lower teeth there yet remain the incisors of the left side and the three molars of the right side. The crowns of the teeth are very much worn down, especially those of the front teeth. The wear on the lower lateral incisor has been from side to side and not from before backwards. The degree of wear corresponds in general to No. 3 of Broca's scale. Every one of the nine teeth present is more or less affected by caries, these being unusually large in the molars of the lower jaw.

TRUNK.

The vertebræ and ribs are of the usual number. The first rib is extremely short and atavistic, even after making due allowances for the general slightness of the skeleton. The sternum presents no peculiarity whatever. Like the other bones of the skeleton it is slight, short and very narrow. The length of the manubrium is 47 mm. and the greatest width 50 mm. The length of the body is 99 mm. Thus the general rule prevails here, the body of the sternum in males being a little more than double the length of the manubrium. The clavicle is short, thick, massive and only measures 118 mm. in length, whereas a length of 145 mm. for a European clavicle would not be excessive.

Scapula.— The body of both right and left scapulæ is exceedingly delicate and thin, so much so that there occur, especially in the left, numerous irregular foramina, there being one in the supra-spinous region with a diameter of 15 mm. There is also, in the left scapula, a large oval foramen in the centre of the spine just where it is differ-

entiated from the body. In the same bone the configuration in the region of the suprascapular notch is very peculiar, and deserves a brief notice. This notch in Europeans is generally well differentiated and lies just at the posterior border of the base of the coracoid process. In the anthropoid apes a distinct notch does not appear at all, there being simply a gradual curve along the entire superior border. Now in the left scapula we find neither the notch nor the gradual curve. Instead there is a prolongation of the anterior process to within 10 mm. of the base of the spine, then it projects backwards and slightly upwards for a distance of 8 mm.; then it passes upwards and decidedly forward and reaches the crest of the spine. Thus there is formed a squarish notch, the sides of which measure approximately 10 mm. and the posterior superior edge forms with the border of the body proper an extremely acute angle.

This same region on the left scapula is not so anomalous but is of perhaps greater interest, for there is not a notch at all but a clearly defined parabolic curve, which in no wise differs from that of the scapula of the orang.

There is yet another peculiar difference to be noted between the right and left scapula. In the right scapula the external border is decidedly T shaped almost throughout, the outer border being 10–12 mm. broad, but there is no abrupt increase in width as we approach the acromion as is usual, but instead only a gradual widening until the end is reached, where there is the maximum width of 25 mm. The termination of the process is squarish and only projects 22 mm. beyond a line perpendicular to the glenoid fossa. The spine of the left clavicle is decidedly heavier and more massive in every way, and its termination is more typical of the human form than that of the left. The tip of the external border of the acromion extends beyond

the plane of the glenoid fossa about 40 mm. or nearly twice as far as it does in the right clavicle. The coracoid processes are approximately the same in both specimens, except perhaps that that of the left is a trifle more massive. The superior third of the subscapular fossa of the right bone is decidedly more concave than the left, so much so that the supraspinous portion turns sharply forward at an angle of about 45 degrees.

There remains to be noted the character of the inferior borders with their angles. Without attempting to give the degree of the angle with accuracy, for that is well nigh impossible, I may say it is evidently under 35°, which is about the minimum average for man. But the interesting point to note is the fact that the axillary and inferior vertebral borders are nearly straight and form an angle with approximately straight sides, so that there is little difference in this respect from the orang's scapula.

When we consider the measurements of the two bones singularly there is no apparent difference between them, so they may both be given together. The measurements are as follows :—

Breadth	102 mm.
Length	145
Infraspinous length	116

From the first two measurements, there is obtained the scapular index, which in this case is 70.3. This is considerably higher than the average in Europeans, which is about 65. It agrees pretty nearly, however, with the index given by Flower and Garson for Australians and other inferior races, and corresponds to the figure given by Broca for the gorilla. Perhaps of still greater interest is the infraspinous index. Here, according to Dwight, the lowest of the gorilla and chimpanzee exceeds the

highest infraspinous index of man. The infraspinous index of the scapula under consideration is 80. This is exceptionally low, even for very inferior races.

The left scapula has the singular distinction of bearing a rifle ball of lead deeply imbedded and partially covered by new bone growth, in the subscapular fossa just beneath the neck of the spine.

Pelvis.—The individual varieties of the pelvis are so great even in the same race that it seems almost useless to give the measurements of a single specimen. Yet any observations on a skeleton without taking into consideration those of the pelvis, would be decidedly superficial. The pelvis as a whole is remarkably slight and compact. The width between the iliac crests, the maximum width of the pelvis, is 255 mm. which is about what we should expect, considering the general slightness of the entire skeleton. The measurements of the true pelvis are as follows : Antero-posterior diameter 110 mm., transverse diameter 111 mm. This gives approximately 100 as the pelvic index, which is about the usual thing in males—in females the transverse diameter is appreciably longer, relatively, than the antero-posterior diameter, so that the usual pelvic index is somewhat less than 100 for females. The width between the tubersites of the ischia is 118 mm. Of the other numerous and less important measurements which might be taken on the pelvis, I have made only three. The first two are the maximum height, 188 mm., and the maximum width, 158 mm. With these we obtain the height-index of the pelvis which in this case is 80.3.

Sacrum.—The sacrum possesses the usual number of vertebræ, five, and is characterized by its length, which is a feature common to Australians and other inferior races. Its maximum width is 96 mm. while the maximum length is 101 mm. This gives a sacral index of 95. For

the maximum diameter to be less than that of the length is the rule in males, but the index 95 is rather low, even for Australians, as 99 is usually given as the average index and 94, according to Turner, is that of the Andamanese. The average sacral index in the European male is about 112, while that of the anthropoid apes is as high as 87 in the orang. Thus here we have evidence of a low type of skeleton.

LIMBS.

The length of the limbs has already been given. The diameter of the head of the femur is 43 mm. which is considerably less than what we should expect. The neck of the femur is very short, measuring only 21 mm. on the dorsal side. The right tibia is peculiar in that there is a high ridge or crest which surmounts the spinous process of the head and rises to a height of 3 mm. above the lateral tubercles. The fibula is curiously shaped and can be described with great difficulty. Its posterior border is very sharp and this sharp edge extends to the centre of the bone. The inner and especially the outer surfaces are highly concave; in a cross section of the upper extremity it would present an inverted T shape, while toward the centre it is more nearly five-sided, the three larger surfaces being decidedly concave. The humerus is not perforated. The head measures but 39 mm. in diameter.

LIST OF BOOKS AND PAPERS CITED OR CONSULTED IN THE PREPARATION OF THIS PAPER.

1. Cooper, C. Dudley.

Notes on the Skull of an aboriginal Australian. J. A. I. v. xxiii, pp. 153–156.

2. DUCKWORTH, W. L. H.

Crania of Australians. J. A. I. v. xxiii, pp. 284-315.

3. DWIGHT, T.

The Sternum as an index of Sex, Height, and Age. J. of Anat. & Phys. v. xxiv, pp. 527–542.

4. FLOWER, WM. M.

Osteological Catalogue, Royal College of Surgeons. Part I. Man, 1879.

5. FRAZER, JOHN.

The Aborigines of New South Wales, Sydney, 1892.

6. HOVELACQUE & HERVÉ.

Précis d'Anthropologie. Paris, 1887

7. HUMPHREY, G. M.

The Human Skeleton. London, 1858.

8. QUAIN'S ANATOMY.

Vol. ii, pt. i. London, 1893.

9. QUATREFAGES AND HAMY.

Crania Ethnica. Paris, 1882.

10. TURNER, SIR WILLIAM.

Human Crania, and Human Skeletons in Vols. x and xvi of Challenger Reports.

11. WILSON, J. T.

Craniology of Australian Aborigines, pp. 96–100 of Frazer's New South Wales.

INUNDATION IN COVENTRY IN 1607.

The Cittie of Coventrie is situated upon the mount or rysing of a small hill, uppon which place there arose a most strange and dreadfull sodaine inundation, the manner whereof followeth, word for word, as I received it, under the Seale of the Cittie, and signed by Henrie Sewell, Maior of Coventrie.

"Know ye, that we aswel of our owne knowledge, as of the creditable report of our honest neighbors, Cittizens of Coventrie, who have sustayned great losses lately by a sudden floud, which unexpected and suddenly came first into the Suburbes of the Cittie, from whence or where the rayne that caused that sodaine floud, came, we know not, but uppon Fryday morning, being the 17th of Aprill, 1607, about seaven of the clocke, no man suspected any such floud to be, and suddenly between eyght and nine of the clocke that morning, there was a great floud comming towards the Cittie, where upon some seeing it came halfe a myle of, and made it knowne unto some Cittizens to make present hast to save some of their goods, but the water came so abundantly, like the surges of the sea, into the Suburbes and Cittie, that it rose within one houre in some places, three yards, and better in height, more than it was that morning, and overflowed divers medowes, and grounds, & entred through the streetes and houses of the Inhabitantes that dwelt neere the river, to the number of two hundreth, fiftie, and seven houses, besides worke houses, and other houses of office, neere the river, to the great hurt of Tanners, Whittawers, Dyers, Bakers, and Bruers, not only in their household goods, but in carrying away many things, to their great loss and damage."

In witnesse whereof, we have here unto put the common Seale of the Cittie, for such like causes, ordayned the xvij of May, 1607.

Henrie Sewell, Maior.

SOME RESOURCES FOR PROTECTION AMONG REPTILES.

BY REV. WM. P. ALLCOTT.

The changes of color in our common tree-toad are recognized in its specific name *versicolor*. In one found upon a growing orange bush, the upper surface was very green. On a window sill of white the conformity to that color is remarkable.

These creatures being abundant in the oaks surrounding my Boxford parsonage, the writer in 1882 tried a few experiments which, unless such work has already been done, may suggest to some one more thorough and exhaustive study of a matter broader in its relations and interest than might at first appear. What I did was this: Glass jars were lined with leaves, bark, paper or other material. Thus chambers were secured of various colors — *gray* with the bark of red oak, *green* with the leaves, *buff* with decayed birch wood or dead foliage, *blue*, *red*, *white* and *black*, which we may here count as a color. It was found that a confinement of at least twenty-four hours and sometimes of several days was needful to secure the full change.

The same toad was successively placed in these different jars. My notes were too meagre and I am not sure that I tried more than one *Hyla*. The results were as follows: in his blue room my patient was very *green*, and in his

red one less green with patches of reddish hue and some of buff. The other colors of my upholstering he copied more closely, except that in the white chamber he was very green with markings that were almost black. This seemed very strange because, on white surfaces, these batrachians usually conform to them in color, and because with buff there was no green but only shades of light ash. With the darker colors, his hues were generally tones of dark ash.

The markings upon the back remained more or less manifest throughout, but in the green and blackish state merely as a deeper shade of the same color. Thus, in general, I find that the color of the back varies from almost white to a dark ash and from these colors to a leaf green. The buff or reddish patches referred to seemed like an effort towards an unusual result. No alteration of the colors of the toad's inferior surface was observable. Doubtless the effects from exposure on a plain surface of color would differ sometimes from the chromatic changes which come by transmission of light more than by reflection from below. Whether these changes are occasioned through the retina, or by some more direct influence on the epidermis, might perhaps be determined by a simple experiment but one which seemed too cruel for the writer to make. Can it be questioned that all this variation of color is protective and has its relation to discussions on evolution?

The tree-toad, wherever it may be, is difficult to discover. You may hear its note near by, but clinging closely to a limb, where it is usually found, its flattened body conformed in color to the bark and less noticeable for the markings, which simulate lichens and the irregular lines of fracture and shade, it seems only a knot.

This Hyla also has a way of dodging underneath and around its perch and one or two more resources that I

have observed. The renal excretion in this and other reptiles may possibly surprise and disgust fastidious enemies and perhaps the sudden and rattling note of the creature may awaken hesitation and allow escape. When, as a boy, I spent much time in the trees around our house, I was often surprised at the abandon with which these little creatures would jump from the very topmost boughs to escape me. Usually they caught on something as they fell. But when they came down on the gravel path they were not harmed — apparently not even by a moment of stomach-ache! A precipitate leap, then, is a last resort. Except for these and other resources, various birds might count *Hyla versicolor* LeC. a frog for an epicure. I may add one incidental observation on this reptile, namely, its singular unwillingness to get into water. For a creature that has been a tadpole and so recently left some pond this seemed strange, and others may determine whether it is always subject to such a *hydrophobia*.

Some changeableness of color is observable in the familiar toad. In a manure cellar or on the black loam of a swamp he will be almost a negro. Living on light-hued gravel he will be a Caucasian. A very black specimen which I put in a box of white paper changed remarkably in a few days, but not so rapidly as the Hyla.

It is doubtless true that to some extent many other creatures vary in a similar way according to the surfaces on which they live. Whether or not human disease of mind and body may be alleviated by living in light of certain colors, we know that our "animal spirits" vary with the weather. A long period of clouded sky has a depressing effect on most minds. The influence which comes from companionship is a fact of not very remote connection. It would hardly seem that the dark skin of the Ethiopian or the Arab could be explained by tropical

forests or darker terrestrial surfaces. Possibly it might be argued that ages of residence under a luxuriant vegetation evolved the negro skin and that the modifying influence of desert life is seen in the brown of the Bedouin. But where did we get *our pale skin?*

That the psychological influence of mountainous or prairie regions, sea-girt coasts, dense silvas or alpine snows may affect national character is a common and plausible theory — but we have wandered from reptiles.

Our *Bufo Americanus* LeC. is protected from enemies not only by some variation of hue and diurnal repose, but also by an acrid skin and a way he has in extremities of swelling himself, stiffening his hind legs, arching his back and bringing his head to the ground about in the position by which the small boy was formerly instructed to frighten off a mad bull! The toad adds to these strange doings a guttural croak and altogether makes himself so *uncanny* that even a starving crow might well fear to swallow such a possibility of being "hoist with his own petar." These creatures, like many others, find obvious protection in prolific breeding.

Our graceful and beautifully colored ribbon snake, *Eutænia saurita* B. and G., has a device for escape that I have often noticed. When capturing these creatures I have been wont to take them by the tip of the tail. As soon as this snake discovers the hopelessness of escape by other means it will swing itself around in a circle till it twists off the tip which is held and thus, if possible, escapes. The gyrations, so far as I observed, were always in the same direction — from left to right, unless my memory is at fault.

Sitting under a tree, one summer afternoon, like a flash two somethings passed within a yard of me, and paused just beyond in the taller grass, near bushes. I saw imme-

diately that the second apparition was a ribbon snake. With body elevated for half its length or more, quickly turning head and sparkling eye, it was beating the grass for a "leopard frog" which, with croaks of distress and immense leaps, had made for this "cover." My investigation was a benefit to the *batrachian* who made good his escape. If ever I saw anger with myself, it was in the eye and mouth and actions of that serpent, which at first stood his ground and seemed ready to "give it to me." The whole incident awakened a new impression of the intelligence of reptiles, which doubtless is more of a protection to them than we are aware.

Tenacity of life is to be counted as another resource. The diffusion of the vital principle among ganglia and nerves scattered through the body, is the reason why they are so difficult to kill, and recover from such severe injuries and perhaps may explain why they sometimes return to life after having been frozen.

When a student, the writer once undertook to dissect a land tortoise, *Glyptemys insculpta*, Ag. He attempted to put the creature to death with strychine and arsenic, which were apparently of no effect. Cyanide of potassium brought some blood from the reptile's mouth and seemed to cause pain. To end suffering decapitation became necessary, and finally I was obliged to open the body while ganglionic movements continued. Under these circumstances I removed the heart and placed it in a dish of water. There it continued to pulsate for a number of minutes, both its movements and the small discolored current of water being plainly visible. Certainly I ought to have timed the continuance of this action.

My little boy has had a specimen of Blanding's tortoise, *Emys meleagris* Ag., for over a year. It was about half grown, being four and one half inches in length. Late in

the fall, I buried this "turtle" under a foot or more of dry earth placing him on soil at the bottom of a keg in the cellar, and pouring more soil over him. In a day or two, Mr. *Emys* was crawling on top of his covering. Then I buried him in mud but he was soon treading it under his feet. So in despair I put him in his old tub moved to the cellar, with opportunity to stay in the water or out of it as he pleased. He chose the former course. For some weeks he showed signs of life. Then he retreated into his shell, closed it, and remained apparently dormant for several months in the water which did not freeze.

In April last, we brought him out and offered him living earth-worms, the only thing we ever found that he would eat. He refused to touch them for several weeks, but gradually his excellent appetite returned. It was the same with a "wood-chuck" which at about the same time we brought up from his winter's sleep in a barrel. At first he would not touch his tid-bits but after a number of days he awoke to full life and activity.

A full-grown Blanding's tortoise, which we kept for several weeks would never eat anything — perhaps from continued fear, perhaps because he "had his growth." We have sometimes kept "mud turtles" through the entire summer and released them when the first ice came, vigorous but somewhat thin in flesh(!) without their having taken once during this period any visible nourishment. This ability to endure abstinence may perhaps be included under our subject.

ROGER WILLIAMS IN SALEM.

A PAPER READ, OCTOBER 9, 1894, BEFORE THE LOCAL HISTORY CLASS OF THE ESSEX INSTITUTE.

BY MRS. HENRY M. BROOKS.

FROM my earliest childhood, the name of Roger Williams was synonymous with Baptist. I thought he was banished from Salem by Salem people because he was a Baptist and the rigid Puritans would have no person in their dominions who differed from them in any religious doctrine. I was not alone, for I find that was a common belief among those who had never looked into the matter historically. In reading the various accounts and lives of Roger Williams written in his own and down to the present time, I do not find any authority to prove that he ever, while in Salem or Boston, did or said anything which would show that he even knew of the existence of such a sect. He was sometimes called an Anabaptist which was used as a term of reproach and was applied indiscriminately to all who differed in any essential points from the rigid Puritanism of the day. He did probably object to infant baptism, not finding any scriptural authority for it; but so did many others, including President Dunster, President Chauncey and other noted men. In 1638, after his banishment and when he was in Providence, which place he made a refuge for dissatisfied, free-

thinking and persecuted persons, he met with some settlers who called themselves Baptists and Straus says: "It is not surprising that Williams should have felt a leaning toward this sect which throughout its entire history preached the gospel of love, abhorred and abstained from persecution and preëminently maintained the rights of conscience." Williams was baptized by one Ezekiel Holyman and then baptized ten others. "This event has been generally looked upon as the establishment of the First Baptist Church in America." But Williams could not be contented with any creed which did not admit of full liberty of conscience and was connected with this church only about four months. For the rest of his life, more than fifty years, "he did not acknowledge himself as belonging to any denomination."

After this long prelude in regard to what Roger Williams was not, I will give a little sketch of his early life and opinions.

Of Roger Williams' very early life and parentage there has been but little known. Until lately it was supposed that he was a Welshman and educated at Oxford, similarity of names being very confusing, but our fellow-townsman Mr. Henry F. Waters, who is usually correct and who leaves no stone unturned, has come to the conclusion that he was born in London, in 1607, the son of James and Alice Williams; that he was elected a scholar of the Charter House School June 25, 1621, and passed from there to Pembroke College, Cambridge, June 29, 1623; from which college he took his degree in 1626. At any rate he was a well educated man and was versed in five languages besides his own — French, Dutch, Latin, Greek and Hebrew. He early attracted the attention of Sir Edward Coke, the eminent jurist, who was always his patron and friend. Mrs. Sadlier, Sir Edward's daughter,

says "as a youth he would in shorthand take sermons and speeches in the Star Chamber and present them to my dear father." After leaving college he studied law for a short time, but theology was nearer his heart and he soon became a decided opponent to the ceremonies of the church. Even in his young days he had discussions with Hooker and Cotton upon the use of the Common Prayer. "His mind was enriched and expanded with the best learning of the age." The great controversy which divided the English Church was at its height; he thoroughly studied the principles at issue and early placed himself upon the Puritan side. But he went beyond the Puritans: he was firmly convinced that conscience should be free, that no person should be responsible in matters of belief to any other person or persons, but to God alone. He naturally looked to New England as a haven for disaffected people in England and sailed with his wife Mary on the 1st of December, 1630, in the Lion, Captain Pierce, for Boston where he arrived after a long and stormy passage on the 5th of February, 1631.

Roger Williams supposed he should find a state of society in which "he could express the great doctrine which had taken full possession of his soul," but he soon found that freedom of conscience was not allowed. Gammell says "It is a mistake, as has been often remarked, to suppose that they [these Puritans] came to New England with any notions of unlimited freedom of conscience." "It was to escape oppression for themselves, not to secure the boon of freedom to others."

Mr. Wilson, the minister of Boston, being about to return to England for a short period, it is said that Mr. Williams refused a call to preach to the people of that place in his absence on the ground that they were an "unseparated people." At any rate he did not unite with

the people of Boston, but in a few weeks was invited by the people of Salem to become an assistant to Mr. Skelton, Mr. Higginson having lately died, which call he accepted. This drew upon Salem a letter from the General Court warning them of his heretical views, the chief of which was that magistrates had no control over the consciences of men, that their power extended only to breaches of the second table, that is, the duties of man to man; whereas the duties of man to God as stated in the first four commandments were questions not to be interfered with; that every man had a right to follow his own inward light. This was a great error in the minds of these Puritans. The Salem people paid no attention to this letter, but settled Mr. Williams immediately on the 2d of April, 1631. He found his situation, however, very uncomfortable as he was constantly watched and his remarks criticised. Dr. Bentley says "Persecution instantly commenced and before the end of the summer he was obliged to retire to Plymouth." Here he was well received, preaching sometimes as an assistant to the Rev. Ralph Smith and supporting himself chiefly by manual labor, "at the How (hoe) and at the Oar for bread." He associated much with the Indians, studying their language and habits; and sought in every way to do them good. This was of great use to him and to all New England in after life, for the Indians always regarded him almost as a sachem. He says he "had a constant zealous desire to dive into the native language." He published in later life, in 1643, his "Key to the Indian language." He staid in Plymouth about two years, but his heart yearned towards Salem and the Salem people; and accordingly in Aug., 1633, he returned there as assistant to their pastor, Mr. Skelton. During the year following he seems to have been constantly harassed by the magistrates and was several times summoned

to appear at the General Court in Newtown, now Cambridge. Whatever occurred at Salem displeasing to the ministers or magistrates of the Colony was attributed to Williams and he was held accountable. He continued to preach what seemed to him the truth. He objected to an oath being required of any man, particularly an unregenerate man, as taking the name of God in vain. He denounced, as an open violation of natural rights, the law which required every man to attend public worship and to contribute to its support. "No one," said he, "should be bound to maintain a worship against his own consent."

While in Plymouth he had written a treatise which he had presented to the Governor there, showing that kings and countries had no right to claim a land by right of discovery; that, if the land was owned at all, it was by the native inhabitants and should be bought of them; that patents and grants were of no value unless paid for; that King James had no right to call Europe Christendom or the Christian World. The great point which lay heavy on his mind was that, according to the patents, "Christian Kings (so called) are invested with a right by virtue of their Christianity to give and take away the lands and countries of other men." "If the King possesses no jurisdiction over the Indians he could not of course convey a title to their lands."

This paper had not been published and was not intended for the "public eye," but the magistrates averred that it contained "heresy and sedition," and arbitrarily summoned him to appear before them and receive censure. He complied, and wrote letters to the magistrates alleging that his treatise had been written "only for the private satisfaction of the Governor of Plymouth" and with expressions of penitence if he had done anything wrong;

and, though without renouncing his opinions, he offered his book to be burned.

Mr. Skelton, whom Mr. Upham calls his "faithful defender," died in the summer of 1634 and the Salem Church immediately invited Mr. Williams to be its pastor. Again the Court interfered and sent a mandate to the Church that it should not ordain him. Whether the magistrates in Boston had a right thus to interfere has been a cause of much contention.

The Church gave no heed to this injunction, and Roger Williams was regularly installed in Aug., 1634. The independence of the Salem Church was not allowed to go unpunished. From this time forth the Salem Church and Mr. Williams were in constant collision with the authorities.

"In Salem every person loved Mr. Williams. He had no personal enemies. All valued his friendship. He was not afraid to stand for truth against the world. He knew man better than he did civil government. He was a friend of human nature, forgiving, upright and pious." "His preaching was faithful, his doctrines on all the great essentials of Christian faith were sound and his life was of blameless purity." Moreover "Salem began to enjoy unrivalled prosperity and to entertain the proudest hopes." Boston appears to have been jealous of Salem. "It was feared that, in connection with other causes, his resolute spirit and popular talents would give an importance to that town [Salem] that might eclipse the metropolis."

Finally, came the climax. In March, 1635, the people of Salem petitioned for some land between Marblehead and the Cliff, which they said belonged to them, but the Court, as a punishment for contempt of authority in settling Mr. Williams, refused to allow the claim; for in

this community of saints it was not " State controlling the Church, but Church controlling the State." The people of Salem felt this to be a grievous wrong and wrote to other churches in the Bay to instruct their delegates to vote differently. This, as there were no newspapers, was all they could do; but it seemed to the magistrates like open rebellion and accordingly the Salem deputies were deprived of their privileges and disfranchised till ample apology had been made. Mr. Endicott, their principal deputy, was imprisoned for his adherence to the doctrines of the letter.

The ministers, with Mr. Cotton and Mr. Hooker at their head, sent a committee to Salem to deal with Mr. Williams, but he disowned their " spiritual jurisdiction." Then the ministers, at the request of the Court, assembled to consider his case, and to give their advice to the magistrates. They " professedly declared " that he deserved to be banished from the colony for maintaining the doctrine " that the civil magistrate might not intermeddle even to stop a church from apostacy and heresy," and that the churches ought to request the magistrates to remove him. In July Mr. Williams was summoned to Boston to answer to the charges brought against him. He was here solemnly charged with the *crime* of maintaining the following dangerous opinions:

1. That the magistrate ought not to punish the breach of the first table, except when the civil peace should be endangered.

2. That an oath ought not to be tendered to an unregenerate man.

3. That a man ought not to pray with the unregenerate, even though it be with his wife or child.

4. That a man ought not to give thanks after the sacrament nor after meat.

Earnest debate followed, and he was dismissed till the next General Court, which was to meet at Newtown, "to consider these things."

In October he was summoned again for the last time. His opinions had not changed. The Court, instructed by the ministers, decided that he should depart out of their jurisdiction within six weeks. The following is the act of banishment as it stands upon the colony records: "Whereas, Mr. Roger Williams, one of the elders of the church of Salem, hath broached and divulged divers new and dangerous opinions against the authority of magistrates; as also writ letters of defamation, both of the magistrates and churches here, and that before any conviction, and yet maintaineth the same without any retraction; it is therefore ordered, that the said Mr. Williams shall depart out of this jurisdiction within six weeks now next ensuing, which if he neglect to perform, it shall be lawful for the Governor and two of the magistrates to send him to some place out of this jurisdiction, not to return any more without license from the Court."

This act of banishment was passed on the 3d of Nov., all the ministers save one approving it.

The Rev. Dr. Dexter, who has written an elaborate and very interesting book to prove, or to endeavor to prove, "the very great wrong done to the memory of the Puritans of Massachusetts" in the case of Roger Williams, gives us a very graphic picture of this "Particular" Court. After mentioning by name the deputies who were probably present, among whom we find many of our old friends of the past summer (the Salem men conspicuous by their absence), he refers to the ministers of the Bay,

fifteen in number, twelve of whom were certainly there, nine of them were graduates of Cambridge, and nine of them had held rectorships in the "fatherland." He closes with the following words: "Altogether it was a distinguished company; and it may well be doubted whether the Massachusetts of to-day, even under the classic shades of that great university which marks the spot where this Court was held, now almost as well known to the learned world as is that ancient shrine of knowledge whose scholastic robes so many of them were entitled to wear, could call together out of its hundreds of pulpits twelve pastors and teachers who should be their equals in intellect and worth, and in all those imperial qualities which fit men to be the founders of states."

In Salem the whole community was in an uproar. The time had been extended till spring, but his presence was soon considered dangerous, many of the people resorting to his house to listen to his teachings; the fathers of the colony therefore determined to send him to England. They sent for him to come to Boston but he refused on account of ill health. Nothing daunted they sent a small sloop to Salem with a warrant to Captain Underhill to apprehend him and carry him on board a ship which was to sail immediately for England. When, however, the officers went to his house they found he had gone three days before. It was in January, 1636, that Roger Williams left his home in Salem (still standing) for the wilderness; thirty-five years afterwards he says in a letter, "I was sorely tossed for fourteen weeks in a bitter winter season, not knowing what bread or bed did mean."

Here closes the Salem life of Roger Williams. Never again, in the fifty-odd years more of his busy, useful life was he allowed to visit the people whom he loved so well; once only was he allowed to land in Boston on his

return from England, and then only at the intercession of powerful English friends, several noblemen and other members of Parliament.

As his life in Rhode Island has but little to do with our local history, I shall not follow him there, contenting myself with saying that our little sister State may well be proud of its noble founder.

THE CHONDROCRANIUM IN THE ICHTHYOPSIDA.[1]

BY GUY MONROE WINSLOW.

CONTENTS.

[1] Studies from the Biological Laboratory of Tufts College, under the direction of J. S. Kingsley, No. XIX.

I wish here to give credit for some of the material used in these studies. The Necturus larvæ were given to me by Miss Julia B. Platt; for Pipa I am indebted to the late Professor E. D. Cope; Professor Robert Wiedersheim furnished me with the Protopterus material and I began the study of the chondrocranium of this Dipnoan in his laboratory. For Amphiuma I am indebted to Professor O. P. Hay, the first to find embryos of this interesting Urodele, and to the late Professor John A. Ryder, who kindly turned over to me the embryos sent him by Doctor Souchon of New Orleans. The embryo Cæcilians were given me by the cousins Paul and Fritz Sarasin and were a part of the material which formed the basis of their splendid monograph. To all these I return my best thanks.

J. S. KINGSLEY.

INTRODUCTION.

The work, the results of which are given in the following pages, has been carried on in the Biological Laboratory of Tufts College, under the direction of Dr. J. S. Kingsley, to whom the author is deeply indebted, not only for the use of much of the material studied, a considerable part of which was already prepared, but far more for invaluable aid and encouragement during the preparation of this paper. It is also due to Dr. Kingsley to acknowledge the free access to his private library containing a large portion of the literature upon the subject, and to state that the models of the first stage of Amphiuma and the three stages of Necturus were made by him.

In my account of the development of the chondrocranium I have not attempted to treat of the origin of the pro-cartilage cells, but I begin with the first formation of cartilage. These earlier stages have been so ably described by Miss Platt ('93, '94) that there seems no necessity to repeat her account, especially as her discoveries in regard to the ectodermal origin of the cartilage-forming cells were largely made in this laboratory, and have received general support and confirmation in the papers of Kastschenko ('88), Goronowitsch ('92, '93, '93[a]), Klaatsch ('94, '95) and von Kupffer ('95).

One object in these investigations was to ascertain to what extent the primary cranial structures throw light upon some problems in the classification of certain Ichthyopsida. The principal of these problems were these:

(1) By most students the Cæcilians have been recognized as a distinct order of Batrachia, but more recently the late Professor Cope in several papers has maintained that these forms were in reality aberrant Urodeles and

should have only family rank in that order. Summarizing his conclusions, he maintained that the Cæcilians were descended from Amphiuma-like forms and these in turn were offshoots from some amblystomoid Urodele. The cousins Sarasin, while agreeing with Professor Cope in the view that the Cæcilians and Amphiuma were nearly related, regarded the relationship as differing in this respect. Amphiuma was a neotenic Cæcilian, a larval Cæcilian become sexually mature. My problem was to ascertain in how far the chondrocranial structures gave support to any of these views.

(2) The fact that the Dipnoi possess lungs led to the view, which has obtained wide acceptance, that these ancient fish-like forms were the ancestors of the Batrachia, and this view has received no little support from Huxley's short but most suggestive discussion of the suspensorial apparatus in the Ichthyopsida. More recently several students have maintained that the Batrachia have sprung from the Crossopterygian Ganoids and that the only relationship that can be traced between Dipnoi and Amphibians is that the lung-fishes may have had the same ancestry, but that they can in no wise be considered as in the line of batrachian descent. In how far does the chondrocranium support either of these views?

It has not been my purpose to enter the broader field of the relationships of these different groups as is shown by other features. I have confined myself closely to the chondrocranium and my results are to be regarded as merely one factor in deciding these questions; a factor in itself of minor importance.

I take as the basis of my studies the development of the chondrocranium of *Amblystoma punctata*, since of this form I have had the most abundant material. This is followed by an account of certain stages of the chondro-

crania of some other Ichthyopsida, and an attempt is made to see how far the chondrocranium can be employed as an aid in the classification of these forms.

The various stages are determined in an arbitrary manner by body length, but it is to be borne in mind that there is considerable variation in embryos and larvæ of the same size. All stages described have been modelled in wax by Born's method, the models have afterwards been carefully measured and compared and all exaggerations of proportion due to slight variations in the thickness of the wax have been corrected in the drawings.

Amblystoma punctata.

First stage. — *Embryo ten mm. long. Mouth on the point of breaking through* (Figs. 1 and 2). This stage, which I have taken as the starting point of my investigations, corresponds closely with that at which Ph. Stöhr begins his classic account of the chondrocrania of Triton and the Axolotl ('79). The chondrocranial elements are still in the pro-cartilage condition but they are clearly differentiated from the surrounding parts by the arrangement of their cells. Three pairs of elements are present, namely, the parachordals, trabeculæ and the quadrates.

The parachordals (*p*) lie as two triangular plates upon each side of the slightly depressed anterior end of the notochord. One side of each triangular plate is directed anteriorly and the antero-exterior angle joins the posterior end of the trabecula, while the inner face of each abuts against the side of the notochord (*n*). The lateral margin of the parachordal runs obliquely outwards and forwards from its posterior angle to the junction with the trabecula. The parachordals arise separately and at this stage touch only at the sides of the notochord, thus leav-

ing the upper and under surfaces and the tip of the latter exposed.

The trabeculæ (*t*) continue forwards in nearly the same horizontal plane as the main part of the notochord, the apex of which, with the adjoining portions of the parachordals, is slightly depressed. The trabeculæ curve first outwards to a point beyond their middle and then in, their apices being about as far apart as their bases. They end medially to the olfactory organs, a little behind the external narial openings. The lower margin of each trabecula is thickened, while above it is developed into a high and thinner crest (*trc*) inclining slightly outwards. The upper margin of this crest is extremely irregular and the foramina for the optic and oculomotor nerves (*of* and *oc*) are but partially enclosed. The crest gradually increases in height from in front backwards to the posterior end of the trabecula where it terminates abruptly.

The quadrates appear as two thin bands of cartilage external to and at some distance from the parachordals. They are concave anteriorly and their general direction is downwards and outwards. In each quadrate can be already recognized three portions, a middle piece constituting a body (*bq*) from which arise an upper ascending process (*ap*) directed forward, inward and upward toward the crest of the trabecula, and a lower descending process (*dp*) running outward, forward and downward to the articulation with Meckel's cartilage. The body is somewhat lenticular while the processes are thin and more laminate.

Meckel's cartilage (*m*) is already complete. The general course of each ramus is obliquely inward and forward until about the middle point where it curves still more strongly inward to meet its fellow of the opposite side. At its base each ramus is stout but it tapers regu-

larly and is slender at the point of union. A point which seems to me of considerable morphological importance is that the symphysis is considerably behind the apices of the trabeculæ, recalling in this embryonic stage the conditions which are permanent in the Elasmobranchs and lower Ganoids.

SECOND STAGE.— *Embryo, eleven mm. long* (Fig. 3). The parts described in the first stage have chondrified rapidly and two new pairs of cranial elements, the otic capsules and the two processes of the occipital arch, have made their appearance.

The occipital arch (*ocp*) is composed of two isolated conical pieces of cartilage, the bases of which rest upon the sides of the notochord a little behind the otic region. From the notochord they curve outwards and upwards, half encircling the medulla and terminating freely. The incompletely developed otic capsules (*o*) are represented by thin layers of cartilage, very irregular in outline, covering the lateral and portions of the dorsal and ventral surfaces of the auditory vesicles. Their anterior ends lie immediately behind and above the bodies of the quadrates while their posterior ends are somewhat nearer the median line, just in front of the occipital arch. The ventral walls of the two capsules are in nearly the same horizontal plane with the notochord and the parachordals. There are no cartilaginous connections between the capsules and the rest of the chondrocranium.

The parachordals (*p*) have fused with each other at the apex of the notochord and now extend back along its sides to about the middle of the otic region where each gives off a lateral process which underlies the median portion of the sacculus. Although the median wall of the otic capsule is as yet but slightly developed, its future line of fusion with the parachordal is clearly indicated by a longitudinal marginal thickening of the latter.

Accompanying the general growth of the head and the lessening of the cranial flexure, the trabeculæ (*t*) have increased considerably in size, more especially in length. At their anterior ends they have become slightly broadened and flattened to form the cornua trabeculæ (*c*), the first indications of the nasal capsules. The gaps between the disconnected portions of the trabecular crest of the first stage are now filled, forming a plate, the dorsal margin of which is a smooth, undulating line sloping gradually downward in passing from behind forwards. The foramina for the optic and oculomotor nerves are now completely enclosed.

Several noteworthy changes have occurred in the quadrate (*q*). Its body and descending process have grown broader and thicker, and two lateral projections from the latter form a transitory support at the base of the balancer (*su*). At the time of its most complete development this support has the form of a shallow cup, the rim of which coincides with the circumference of the base of the balancer. The ascending process has extended upward and has fused with the posterior end of the trabecular crest. A slight backward projection from the body of the quadrate is the first trace of the otic process.

Third stage.—*Larva twelve mm. long* (Figs. 4–7). The distal ends of the occipital processes (*ocp*) have fused with the postero-dorsal walls of the otic capsules, and their proximal ends have fused with the posterior ends of the parachordals. A solid floor is thus formed beneath the medulla, and the jugular foramen (*j*) is enclosed by cartilaginous walls.

The parachordals (*p*) with the notochord now form a complete basilar plate below the posterior half of the brain cavity except at one small place (*f*) upon the left side which still remains unchondrified. With the excep-

tion just mentioned, the lateral margins of the parachordals are now everywhere continuous with the floors of the otic capsules.

The otic capsule (*o*) now presents the typical capsular form, covering by far the greater part of the surface of the auditory vesicle. The median wall is beginning to form along the dorsal margin and at the two ends of the capsule, leaving two unchondrified spaces in the middle and ventral region; a large anterior one through which pass the seventh and eighth nerves and the endo- and perilymphatic ducts, and a smaller fontanelle lying postero-dorsally to the first. In the floors of the capsules are the foramina for the exit of the branches of the seventh nerve (*vii*). Upon the left side the two branches of this nerve pass through the two ends of a transversely elongated foramen, while upon the right side they pass through two separate foramina formed by the fusion of the middle portions of the anterior and posterior walls of the originally elongated foramen. Behind the foramina for the seventh nerve and somewhat farther laterally is the large fenestra ovalis (*fo*). The stapes (*s*) which arises from a separate centre of chondrification occupies the anterior end of the fenestra.

The only noteworthy changes in the trabeculæ are a general strengthening and an increase in the size of the cornua (*c*). The quadrate has become more solid throughout all its parts except the processes which were at the base of the balancer in the preceding stage. They have disappeared together with the balancer, leaving a single conical process in the place they formerly occupied. The otic process (*op*) extends considerably farther backwards than before.

FOURTH STAGE.—*Larva thirty-nine mm. long. Gills not yet atrophied* (Figs. 8–11). The ventral portion of

the occipital arch is in essentially the same condition that it was in the third stage. So also are the parachordals, except that the union with the capsular floor is now complete upon both sides.

The otic capsules present several new features. From their point of fusion with the occipital processes marginal expansions (Figs. 9 and 11, *loc*) extend medially over the sides of the cranial cavity. Passing forwards they approach each other and unite to form the synotic tectum (*st*) which terminates anteriorly in a short median process (*tm*) the "tænia tecti medialis" of Gaupp. In the median wall of the capsule there are now four small apertures, of which three (Fig. 11) lie in a horizontal row near the floor of the cranium, while the fourth is more dorsal in position. Passing from in front backwards, the first foramen of the row is the one traversed by the seventh and one branch of the eighth nerve (*vii*+*viii*). The second branch of the eighth passes through the second foramen (*viii*), and the third aperture of the row is traversed by the perilymphatic duct (*pf*). The fourth aperture, higher up in the wall above the foramen for the second branch of the eighth nerve, is the foramen for the endolymphatic duct (*ef*).

At the anterior end of the otic capsule there are three new connecting cartilages joining it with the trabecula on the one hand, and on the other with the quadrate. The process joining the postero-dorsal point of the trabecular crest with the opposite wall of the capsule is relatively slender; while the other two processes, the otic (*op*) and palato-basal (*pb*), are formed by the fusion of a greater part of the dorso-median surface of the body and otic process of the quadrate with the adjacent wall of the capsule and the margin of the basilar plate. A blood vessel, which passes dorso-ventrally around the anterior end of

the capsule, is the only line of demarcation between the otic and palato-basal processes. A large chamber is enclosed between the posterior end of the trabecula, the anterior end of the capsule and the bars connecting them dorsally and ventrally. The ascending process of the quadrate passes across its external surface, separating a dorsal and a ventral foramen. The Gasserian ganglion occupies this chamber and from it pass out the ramus ophthalmicus profundus (*rp*) through the ventral foramen, and the rami ophthalmicus superficialis (*rs*), maxillaris (*rm*), and mandibularis (*rn*), through the dorsal foramen.

The foramina by which the rami of the seventh nerve leave the otic capsule are unchanged, except that now there are two upon each side and that they are considerably reduced in size. The fenestra ovalis (*fo*) is now nearly filled by the stapes (*s*), which has a slight prominence directed outwards and upwards from the antero-dorsal angle of the cartilage towards the otic process of the quadrate. These cartilages, however, do not become united at any time during the development of Amblystoma as they do in some other forms.

The trabeculæ (*t*) are of nearly uniform size from their junction with the parachordals to the point where they meet in front in the ethmoid plate (*e*). Optic and oculomotor foramina are of equal size, both being small. The ethmoid plate (*e*), arising by the fusion of the anterior ends of the trabeculæ in the median line, forms a continuous floor beneath the anterior end of the cranial cavity, the nasal septum (*ns*) and portions of the olfactory organ. In front it terminates upon each side in a conical process. Laterally a freely ending process (*c*) extends backwards along the ventral surface of the olfactory organ. This and the adjacent parts of the ethmoid plate are develop-

ments of the cornua of the earlier stages. In the same plane with the ethmoid plate and just behind its posterior end, a flat antorbital process (*anp*) projects from the side of the trabecula and, curving forwards, terminates directly behind the backward projecting process of the ethmoid plate.

A broad nasal septum rises from the middle of the ethmoid plate separating the two olfactory organs and forming the anterior wall of the cranial cavity. Bars of cartilage, which I have called the tectal cartilages (*tc*), connect the antero-dorsal points of the trabeculæ with the opposite points of the septum, roofing over the olfactory foramina and forming the bases from which curved processes, laminæ cribrosæ (*e*), extend outward, downward and forward, covering over the posterior ends of the olfactory organ.

The quadrate (*q*), besides its fusion with the otic capsule as already mentioned, now presents a well developed pterygoid process (*pt*), a cylindrical rod of cartilage joining the main part of the quadrate at the point where the ascending process meets the body. Its general direction is forwards, parallel with the trabecula as seen from above, and downwards with a slight outward curve near the tip which lies just below the ventro-median surface of the orbit.

FIFTH STAGE. — *Young Amblystoma sixty-nine mm. long. Gills entirely atrophied* (Figs. 12–13). At this advanced stage in the development of Amblystoma, ossification has occurred to so great an extent that large portions of the older cartilages have disappeared, giving the chondrocranium a broken and ragged appearance, especially in the otic region. The median capsular wall, the anterior end of the basilar plate and portions of the occipital arch, and the trabeculæ are entirely replaced

by bone. At the same time the whole skull has increased in breadth as compared to its length.

The synotic tectum (Fig. 12, *st*) is completely separated from the remnants of cartilage forming the otic capsules, and the basilar plate (*p*) is reduced in length to little more than that of the tectum. Ossification has removed nearly all of the cartilage of the capsule behind the posterior end of the fenestra ovalis where the stapes is now closely applied against the remnant of the cartilaginous wall of the capsule.

The quadrate (*q*) has undergone important changes, due in part to ossification and to the lateral expansion of the skull. Its body is thicker antero-posteriorly and stands out farther from the capsule. The descending process is cylindrical in shape, presenting greater definiteness of outline than previously. Irregular perforations of the cartilage occur along the line where the quadrate joins the capsule. Most striking of all is the change in the position of the pterygoid process (*pt*) which, instead of being nearly parallel with the long axis of the skull as in the previous stage, now slants from its base outwards at an angle of about thirty degrees from that axis.

The cartilaginous nasal capsules have reached their highest stage of development and present many new and important features. The nasal septum (Fig. 12, *ns*) is narrowed down to about half its former width. In front it divides into two doubly curved plates which extend forwards and outwards to the cup-like anterior ends of the capsules. From the ventro-median surface of each of these plates a short knob-like process extends forwards and terminates the capsule anteriorly.

A flattened band of cartilage which I have called the ventral process (*vp*), in contradistinction to the dorsal

process (*d*) to be described later, passes backwards from the ventral margin of the cup-like anterior end of the capsule. At its posterior end this process fuses laterally with the lamina cribrosa (*l*) while medially it terminates in a process projecting freely backward (Fig. 13, *vp*).

The cylindrical dorsal process (*d*) extends diagonally across the anterior end of the olfactory organ from the dorso-median margin of the cup to the anterior end of the lamina cribrosa. A short connecting rod joins the dorsal process and lamina cribrosa with the ventral process in front of the nasal duct (*nl*). As in the preceding stage, the lamina cribrosa forms a roof over the posterior end of the olfactory organ. It now reaches downwards to meet the outer end of the antorbital process thus enclosing the orbito-nasal foramen (*on*), and outwards and forwards to meet the ventral and dorsal processes as described above. It is perforated near the lateral margin by several small foramina through which pass a branch of the ophthalmicus profundus (*rp*) and some small blood vessels (*b*). A branch of the nasalis internus (*ni*) passes out of the capsule through the foramen in its median wall.

Desmognathus fusca (Fig. 14).

The chondrocranium of *Desmognathus fusca*, of which I have modelled two stages, presents so great a similarity to the earlier stages in Amblystoma that only a few words need be devoted to it. Figure 14 represents the model of the skull of an embryo about twenty mm. long.

The parachordals (*p*) are represented by three narrow bands of cartilage; one extending between the posterior ends of the otic capsules and having the notochord partly imbedded in it, and two other bands which connect the apex of the notochord with the posterior ends of the trabeculæ.

The entire absence of a stapes in the history of the chondrocranium is the only noteworthy point of difference between the formation of the ear capsules in Desmognathus and in Amblystoma. The trabeculæ and quadrates present conditions essentially the same as those of a corresponding stage in Amblystoma, but owing, in part at least, to the early appearance of the bony skull in Desmognathus no complex nasal capsule is formed. The simple condition shown in Fig. 14 is the highest state of development reached by the anterior ends of the trabeculæ. A small antorbital process develops in the usual place upon the side of the trabecula. No pterygoid process of the quadrate appears in either of the stages modelled. As the older stage presents a state of development approximately equivalent to that found in the fifth stage of Amblystoma the appearance of this process as figured by Wiedersheim ('77) must be a comparatively very late occurrence.

Plethodon glutinosum (Fig. 15).

From a specimen of *Plethodon glutinosum* twenty mm. in length and showing the chondrocranium in an advanced stage of development, I have modelled the nasal capsules. In regard to the rest of the skull mention of a few points will suffice.

In the main it corresponds closely with the skull of Amblystoma as described in our fifth stage (Figs. 12 and 13). This similarity is especially noticeable in the position of the pterygoid process. There is a stapes, the antero-dorsal point of which, unlike that of Amblystoma, is connected to the quadrate by a very slender stapedial process. The otic and palato-basal processes present the usual conditions.

Aside from the rod connecting the dorsal and ventral

processes in front of the narial duct all the parts described for the nasal capsule of Amblystoma are found in approximately the same positions in Plethodon with unimportant modifications as to relative sizes. This similarity is even more apparent in older specimens of Plethodon than in the one from which this model was made. The two small foramina in the lamina cribrosa mark the points at which a branch of the ophthalmicus profundus (*rp*) enters and leaves the capsule.

Necturus maculatus.

Cope ('89) has placed *Necturus maculatus* with its American relative *Necturus punctata* and the European Proteus in a group together under the name Proteida with the remark that they occupy a position intermediate between the Stegocephali and the Urodela, and differ from the latter mainly in the possession of an intercalary bone. Descriptions of three stages in the development of the chondrocranium of *Necturus maculatus* are here given.

First stage. — The first stage represents the skull of an embryo twenty-one mm. in length, and corresponds approximately to the condition found in Amblystoma at a time a little earlier than that represented in the third stage of the latter (Figs. 4-7). The occipital arch consists of two processes extending upward from the sides of the notochord and ending freely above. At their bases they are connected with the posterior ends of the parachordals.

The parachordals run forward from the bases of the occipital processes, slightly removed from the sides of the notochord. Between the posterior ends of the otic capsules they bend inwards and touch the sides of the notochord to which they are attached for a short distance, then curve sharply outward, and, fusing laterally with the cap-

sular floors, continue forward into the trabeculæ. The notochord projects forward some distance in front of the most anterior point at which the parachordals touch its sides. The otic capsules are widely separated and incompletely formed. Their floors are partially attached to the parachordals and the only traces of the median wall are found around the inner margins of its walls. A large fenestra ovalis, with no stapes, and a large foramen for the exit of branches of the seventh nerve constitute the only well defined apertures which are found in later stages.

The trabeculæ extend forwards from the anterior ends of the parachordals as long slender rods running parallel for the posterior three-fourths of their length and then bending inward at an angle of about thirty degrees towards the median line, which they do not reach. There are, as yet, no foramina for the second and third nerves and only a slight trace of a trabecular crest to which the ascending process of the quadrate is attached.

The quadrate is wedge-shaped as seen either from the side or in front, the point being directed ventrally. A short otic process extends upward and backward from the dorso-lateral angle of the wedge and fuses with the otic capsule, while a longer ascending process extends upward and forward from the dorso-median angle and fuses with the dorsal end of the slightly developed trabecular crest.

Second stage. — Our second model is that of an embryo twenty-four mm. in length. The occipital processes are fused distally with the walls of the otic capsules and continue along the dorso-median angles of the capsules as the beginnings of the synotic tectum. The jugular foramen is at this stage a dorso-ventrally elongated slit.

In place of the distinctly outlined parachordals of the previous stage we now have a continuous basilar plate

lying beneath that portion of the cranial cavity included between the posterior halves of the otic capsules. As before, the notochord projects freely forward in the median line. Laterally and in front the basilar plate merges into the capsular floors and the trabeculæ.

The otic capsules present essentially the same conditions found in stage three of Amblystoma (Figs. 4–7) except that the otic process of the quadrate is fused with the antero-ventral surface of the capsule. A trabecular crest just large enough to enclose the optic and oculomotor foramina and to form a point of attachment for the ascending process is now developed. The appearance of simple antorbital processes upon the sides of the trabeculæ is the only further change which needs mention here.

THIRD STAGE.— *Larva forty-five mm. long* (Fig. 16). A continued fusion of the margin of the occipital process with the wall of the otic capsule, resulting in a reduction of the size of the jugular foramen is the most noticeable change in this region. The synotic tectum is now fully developed and presents the usual form. The basilar plate remains the same as in the previous stage.

The otic capsules have reached their highest state of development. The median wall is perforated by four foramina which correspond almost exactly to those described for the otic capsule of the fourth stage of Amblystoma (Fig. 11). In fact the only differences of any importance between the otic regions of this skull and that described as the fourth stage for Amblystoma are in the absence of the parachordals at the anterior end of the notochord, and the more median position of the foramen for the palatine nerve (*pal*). A small crest is now developed along the posterior half of the trabecula. A slender connecting rod unites the posterior end of the crest with the opposite wall of the otic capsule. Antorbital processes project outward and forward from the sides of the trabeculæ.

By a fusion of the anterior ends of the trabeculæ in the median lines a small ethmoid plate is formed, upon the anterior end of which is a slight prominence, the only indication we have of a nasal septum. Upon each side a short forward-projecting process terminates the ethmoid plate anteriorly.

Entirely separated from the rest of the cartilaginous parts of the head there is now a delicate nasal capsule (Fig. 16, *nc*). It consists of a curved rod, which runs along the dorso-median surface of the olfactory organ, following more or less closely the direction of the anterior end of the trabecula and the ethmoid plate, and a number of shorter processes projecting laterally from this main rod over the top of the olfactory organ. As Pinkus ('94) has pointed out, there is some resemblance between this nasal capsule and that of Protopterus, but it seems to me hardly necessary, for reasons which will appear more fully later, to attach any importance to this similarity other than that of a coincidence.

One would seem justified in expecting that, if Necturus occupy a position intermediate between the Stegocephali and the Urodela, the chondrocranium of Necturus would show more or greater differences from the typical Urodele chondrocranium than are found in higher Urodeles, the Urodela of Cope. But I am unable to discover that this is the case. It would be difficult, rather, to point out a form in which the chondrocranium is more typically Urodelan.

Amphiuma means.

The first of the two models of the chondrocranium of *Amphiuma means* here described is the one which formed the basis of the description of the chondrocranium in Dr. Kingsley's preliminary paper upon "The Head of an Embryo Amphiuma" ('92). The chondrocranium of

another specimen from the same lot of embryos was also described and figured by Professor O. P. Hay in his paper of '90.

FIRST STAGE.— (Figs. 17–18).—The occipital processes have fused with the otic capsules and their distal ends project inward over the sides of the cranial cavity as the first steps in the formation of the synotic tectum. The parachordals (Fig. 18, *p*) extend forward from the bases of the occipital processes, and, after curving inward to the sides of the notochord and fusing beneath it, they each divide into a median and a lateral band. The lateral bands of the two sides curve outward and, fusing with the capsular floors, pass forward to the posterior ends of the trabeculæ. The median bands separate in front of the apex of the notochord, bend laterally and join the lateral bands again at their junction with the trabeculæ. Between these two parts of each parachordal a fontanelle is enclosed.

The otic capsules present nearly the same condition as that found in the fourth stage of the skull of Amblystoma. But here, as was also noted in Necturus, the foramen for the palatine branch of the seventh nerve (*pal*) is on the median side of the median capsular wall.

The trabeculæ extend from their union with the parachordals forward to the nasal region, where they fuse in a small ethmoid plate which is terminated anteriorly by two broad triangular cornua. Along the middle and posterior end of each trabecula is a well-developed crest covering in the optic and oculomotor foramina as usual. It is connected postero-dorsally with the anterior end of the otic capsule, and it is also connected with the median angle of the quadrate by means of the ascending process (*ap*). The point at which the ascending process joins the trabecula is relatively farther anterior in Amphiuma than in Amblystoma, thus producing more elongate foramina for the exit

of the nerves coming from the Gasserian ganglion (Fig. 18, *v*). Antero-dorsally the crest gives rise to a rod of irregular shape, which projects forward, outward and downward. This is the lamina cribrosa (*e*). Below and a little behind this the antorbital process is just beginning to appear upon the side of the trabecula.

The quadrate is rhomboidal in outline when viewed from the side. It is connected with the trabecular crest by the ascending process, as mentioned above, but as yet it has not fused with the otic capsule. From its posterior angle a slender stapedial process (Fig. 17, *sp*) extends backward into the anterior end of the fenestra ovalis where it joins the small stapes. No pterygoid process is yet developed. Meckel's cartilage articulates with the antero-ventral surface of the quadrate.

SECOND STAGE.—(Fig. 19).—In the second stage of the chondrocranium of Amphiuma, ossification is far advanced. The most important additions to the cartilages are seen in the completed nasal capsule and the pterygoid process (*pt*) of the quadrate which is now developed.

The distal ends of the occipital processes have developed into a narrow synotic tectum, while the notochord and median portions of the parachordals have disappeared except in the occipital region, where they form a ventral band (*p*) connecting the two capsules. No changes worthy of notice have taken place in the otic capsules aside from the results of ossification.

The trabeculæ are divided into anterior and posterior portions by ossification in the orbital region. The posterior portion remains essentially the same as in the first stage, but the anterior portion is changed by the formation of the nasal capsule. The base of the antorbital process (Fig. 19, *anp*) marks the posterior end of that portion of the trabecula remaining unossified in front of

the optic foramen. A narrow column of the trabecular crest projects upwards from just in front of the base of the antorbital process, and upon the anterior end of the ethmoid plate a thin nasal septum is developed. Two cartilages upon each side arise from the dorsal end of the septum. From its posterior end a cylindrical rod, the tectal cartilage (*te*) extends backward and outward to the dorsal point of the remnant of the trabecular crest. From the posterior end of the septum a band of cartilage extends forward and expands into a broad sheet, the nasal tectum, roofing over the whole anterior portion of the olfactory organ. Where the nasal duct passes out to the exterior (*nl*) at the anterior end of the tectum, a complete ring of cartilage encircles it. Laterally the nasal roof is connected by a band curved ventrally with the cornu (*c*) of the trabecula. And from the postero-lateral margin of the tectum a flattened rod (*l*) passes backward to the tectal cartilage, fusing with it at a point just above the anterior end of the antorbital process.

While it is impossible to homologize all the parts of the nasal capsule of Amphiuma with those in Amblystoma there are some points in which the similarity between them is very close. The septa, ethmoid plates, and tectal cartilages are essentially alike in both. The lamina cribrosa and dorsal process of Amblystoma are represented in Amphiuma by the rod connecting the tectal cartilage with the nasal tectum. The open anterior end of the capsule of Amphiuma is quite different from the cup-like end of Amblystoma to which it must be compared. This difference in the capsules is, of course, correlated with the relative change of position of the nostrils, which are at the anterior end of the capsules in Amphiuma and in the middle of the sides of the capsules in Amblystoma. In Amphi-

uma the antorbital process does not become fused with the lamina cribrosa.

The quadrate is now supplied with a pterygoid process (*pt*) which runs forward from the ventral surface of the ascending process in close proximity with the ventral margin of the trabecula. Towards its anterior end it curves laterally and broadens out into an oval plate. Its anterior end lies a short distance postero-laterally from the base of the antorbital process. Otic and palato-basal processes unite the quadrate with the otic capsule. The stapes has expanded into a broad plate nearly filling the fenestra ovalis. It is still connected with the quadrate by a strong stapedial process (*sp*).

Characteristics of the Urodele Chondrocranium.

From the preceding descriptions of the chondrocrania of various Urodeles, we may briefly enumerate the more important characteristics of the cartilaginous skull as found in this group.

Two occipital processes, the early history and relationships of which have been more fully treated by Ph. Stöhr ('79), arise independently at the sides of the notochord in front of the first permanent vertebra. The similarity between these processes and those of which the vertebræ are formed clearly indicates the vertebral nature and origin of the occipital arch. From the sides of the notochord the occipital processes pass upward, fuse with the walls of the otic capsules and bend over medially to form the synotic tectum (Fig. 18, *ocp*). Two large jugular foramina are enclosed between the bases of the occipital processes and the posterior ends of the otic capsules. Parachordals, varying in size and extent from the narrow bands of Desmognathus (Fig. 14, *p*) to the complete

basilar plate of Amblystoma (Figs. 9 and 10 *p*), form a more or less complete floor beneath the otic portion of the brain cavity. The otic capsules are approximately oval in shape and in all cases have a median wall distinctly separating the cavity of the capsule from that of the brain. There are generally four foramina in this wall through which pass the seventh and eighth nerves and the endolymphatic and perilymphatic ducts. In the ventro-lateral wall of the capsule there is a large fenestra ovalis which may or may not be occupied by a stapes. When present the stapes appears first at the anterior end of the fenestra and only later, if at all, does it reach back to the posterior wall of this aperture. The stapes may be connected with the quadrate by a stapedial process.

Trabeculæ, either slender rods with barely enough crest to cover in the optic and oculomotor foramina as in Desmognathus, or solid beams as in Amblystoma, connect the parachordals and otic capsules with the nasal capsules. At its posterior end there are two places at which each trabecula joins the cartilages of the otic region. Of these points of fusion, the ventral, joining the base of the trabecula with the parachordal, is formed early, while the dorsal, joining the trabecular crest with the otic capsule, is a later occurrence. Anteriorly the trabeculæ usually bend inward, and, fusing in the median line into an ethmoid plate, take part in the formation of somewhat complex nasal capsules. But here, again, Desmognathus, with nothing more complex than cornua trabeculæ (Fig. 14, *c*), proves an exception to the general rule.

An antorbital process projects outward and forward from the side of the ventral margin of the trabecula behind the olfactory organ. In some forms it later fuses with the other parts of the nasal capsule. The variety of forms shown by the nasal capsules of the different

species described renders it difficult to make any accurate statements in regard to these organs which shall apply to the group as a whole. More extended study may show the prevalence of a limited number of these types as is suggested by the similarity between Amblystoma and Plethodon.

Quadrates, arising independently near the anterior end of the otic capsules, later become attached to the rest of the skull by three or four processes. The ascending process unites it with the trabecular crest; the palato-basal with the parachordal; the otic with the otic capsule; and the stapedial process, when present, unites it with the stapes. The palato-basal and otic processes become so intimately related that the blood vessel running between them is the only line of demarcation. A pterygoid process running forward from the body of the quadrate may or may not be present. When present it ends freely in front, not coming in contact with the anterior end of the trabecula and nasal capsule as occurs regularly in the Anura. Ranodon forms the only known exception among the Urodeles to this last statement.

Pipa americana (Figs. 20–21).

In the single stage of the chondrocranium of Pipa which I have modelled, ossification has proceeded so far that many of the cartilages appear only as remnants of what they were earlier. A brief outline of this skull, however, may serve as a basis from which, with the aid of other studies upon the Anura, especially Gaupp's exhaustive work upon *Rana fusca*, we may contrast the chondrocranium of this group with that of the Urodela.

The occipital processes have fused with the otic capsules and their distal ends have developed into the synotic

tectum. The parachordals are reduced to a narrow transverse band immediately in front of the base of the occipital arch, and short lateral bands fused with the floors of the otic capsules. The greater part of the wall of the otic capsule is ossified, but enough of the lateral wall remains to show the most important relationships. In this lateral wall of the capsule, further dorsally than in the Urodele skull described, is the fenestra ovalis and in it a small stapes (Fig. 20, *s*) which is connected by a rod running forward and downward with the lateral border of the tympanic annulus (*ta*).

The trabeculæ are small, cylindrical rods extending forward from the ventro-median angles of the anterior ends of the otic capsules and fusing in the broadly expanded ethmoid plate. In the median line the ethmoid plate is continued forward into the nasal septum. At the sides of the posterior end of the septum the ethmoid plate is perforated by the olfactory foramina (*ol*). A triangular lamina cribrosa (*l*) projects outward, downward and forward from each antero-lateral margin of the ethmoid plate. This and the septum with the connecting rods compose the nasal capsules.

From the ventro-lateral margin of the lamina cribrosa (Fig. 21) a slender cartilage projects horizontally inward to beneath the inner border of the lamina where it splits into two cylindrical rods, a dorsal and a ventral. The dorsal rod (*d*) extends forward inward and upward to the antero-dorsal point of the septum, while the ventral rod (*vp*) curves sharply inward, touches the ventral margin of the septum and then, slightly expanding in width, terminates in a process projecting freely forward. A small foramen for the orbito-nasalis, seen only when the skull is viewed from below (*on*), passes beneath the posterior end of the lamina-cribrosa just outside the anterior end of the

trabecula. The short so-called 'palatine cartilage' is, as has been shown by Gaupp, the homologue of the antorbital process of the Urodela.

The quadrate is situated much nearer the posterior end of the skull than that of the Urodela described. It lies about under the middle of the lateral wall of the otic capsule, to which it is connected by means of a dorsal otic and a ventral palato-basal process. There is no stapedial process connecting the quadrate directly with the stapes, but, as was mentioned above, the stapes is connected with the tympanic annulus which is earlier derived from the quadrate. A slender palato-pterygoid process (*ppt*) projects forward from the body of the quadrate and fuses with the lateral margin of the lamina cribrosa. The relatively posterior position of the quadrate adds proportionately to the length of Meckel's cartilage.

Anura and Urodela contrasted.

From a general view of the chondrocrania of these two groups it is seen that, on the whole, in the Anura the width is greater in proportion to its length than in the Urodela. But since there are many very short and broad skulls among the Urodela this distinction is of little value. The closure of the cranial cavity is more complete in the Anura, especially in the ventral region where the basicranial fontanelle, as shown by Gaupp ('93), becomes greatly reduced. Here, too, instead of ending freely, the pterygoid process of the quadrate is attached anteriorly to the ethmoid plate. In these two last mentioned points the Anura show more resemblance to the Selachians than do the Urodela.

We may here insert a few words in regard to the homologies and terminology of the cartilages which have

been variously called the 'antorbital process' and the 'palatine cartilage.' Gaupp ('91) maintained the homology of the 'antorbital' of the Urodela with the palatine of the Anura. Speaking of this cartilage in Amphiuma, Kingsley ('92) said, "the lower process may retain the name, antorbital, usually applied to it, for Amphiuma presents no evidence that it is the palatine cartilage as Gaupp interprets it." In his final paper on the chondrocranium of Rana, Gaupp ('93) repeats his former position and, stating that he uses the two terms interchangeably, comments upon the above quotation as follows: "Kingsley scheint unter 'Palatine Cartilage' hier etwas Besonderes zu verstehen; was das ist, kann ich aus seinen Angaben nicht ersehen."

There seems to be no doubt as to the correctness of the homology of the cartilages as pointed out by Gaupp. The question here, however, is one of terminology and it is not to be settled by the fact that certain authors have called this cartilage the palatine, but upon the broader grounds of comparative anatomy, and here the question of priority must also be taken into account. The term palatine bone in some of its various modifications was first applied to a bone occurring in the palatal region of the Mammalia, and, in transferring the name to other classes of vertebrates, it is obligatory that it should be given only to those structures which are homologous with the palatine of mammals. That the palatine *bone* of the Amphibia is homologous with the palatine bone in the mammals I do not deny, but I maintain that this cartilaginous process is in no way a palatine process but that rather its relations are with the nasal capsule, and for the following reasons:

In the mammals the palatine bone is regularly enumerated among the membrane bones (Minot '92, *inter alia*) and, so far as I am aware, it has no connection with any

cartilage. To attempt to homologize a membrane bone with a cartilage is a difficult task. If, however, it be maintained that we have here a case of substitution such as exists in the roofing bones (parietals, frontals, etc.) of the cranium, in which the cartilaginous roof of the brain cavity becomes replaced by the immigration ot dermal bones, Ichthyophis throws considerable light upon the question. In this form the palatine bone (part of the maxillopalatine process of the Sarasins), which is distinct in early stages, arises, not in connection with the cartilaginous process in question, but with the nodule of cartilage shown in Figs. 22, 23, and 24, *pc*. In Ichthyophis not only is this true cartilaginous 'palatine' present but the antorbital process occurs as well.

If we adopt the usually accepted homologies (which, however, are not beyond question) the palatine of the higher vertebrates is to be sought in the anterior portion of the upper jaw of the Elasmobranchs, which is accordingly called the palato-pterygo-quadrate or some similar term, implying homologies with the palatine of higher forms. In these very Elasmobranchs, however, the exact homologue of this antorbital process exists, in no way connected with the upper jaw but rather as forming a part of the nasal capsule.

The transformation during metamorphosis from a condition in which the jaw of a small suctorial mouth articulates with the anterior end of the pterygoid cartilage to one in which it reaches back to the body of the quadrate beneath the middle of the otic capsule is one of the most striking characteristics of the Anuran chondrocranium. Another of its distinctive features is found in the auditory apparatus. While in the Urodela the fenestra ovalis may be occupied by a cartilaginous stapes which may or may not be connected with the quadrate by a stapedial process,

in the Anura we find a much more complicated condition. The fenestra ovalis passes through important changes of form and the stapes comes into connection with a tympanic annulus. But if the tympanic annulus was "originally a postero-superior leaf cut off from the mandibular suspensorium," as stated by Parker and Bettany ('77), the fundamental similarity of the conditions in the two groups is apparent. In connection with this point Gaupp says, "Der vom Quadratum losgelöste knorpelige Annulus tympanicus scheint eine dem Anuren allein zukommende Bildung zu sein." Here, as with the Urodela, the nasal capsule offers little that is of classificatory value.

The chief points of difference between the chondrocranium in the two groups may be tabulated as follows:

Urodela.	Anura.
1. Both broad and narrow types.	1. Generally, if not always, broad.
2. Pterygoid free in front (except in Ranodon).	2. Pterygoid attached to ethmoid plate.
3. Basi- and supra-cranial fontanelles large.	3. Basi- and supra-cranial fontanelles smaller.
4. No metamorphosis.	4. Very striking metamorphosis.
5. Auditory apparatus comparatively simple.	5. Auditory apparatus, including the tympanic annulus, complex.

Ichthyophis glutinosus.

First stage.— (Figs. 22 and 23).—The specimen from which the model for this stage was made was a young embryo still spirally coiled within its membranes. While in some places, more particularly toward the anterior end of the head, the tissue modelled is not true cartilage, the differentiation of all the parts is sufficient to cause little difficulty in distinguishing them.

The notochord occupies its usual position at the posterior end of the cranium; but, as it passes forward, it bends downward so that its anterior end lies considerably below the general level of the cranial floor. The parachordals are represented only by a narrow band of cartilage connecting the posterior ends of the otic capsules. In the median line the notochord is embedded in this band. At its lateral margin the parachordal band fuses with the occipital process behind and with the otic capsule in front. The dorsal end of the occipital process is fused with the otic capsule. Between these three cartilages is the jugular foramen (*j*).

The otic capsules are longer, narrower and deeper than those of Amblystoma, and, as is usual in the younger stages, they are comparatively widely separated. In the median wall of each capsule are two foramina, a larger anterior and a smaller posterior foramen. The ventrolateral wall of the capsule is largely taken up by the fenestra ovalis along the dorsal part of which lies the stapes. The stapes is continued forward into a process which reaches the posterior surface of the quadrate. This process may retain the name 'stapedial process,' although in this case it is continuous with the stapes rather than with the quadrate. The stapes is perforated in a dorso-ventral direction for the arteria perforans stapedia (Fig. 23, *as*).

Three processes arise from the anterior end of the otic capsule. Two of these, which I shall call the dorsal (*dr*) and ventral (*vr*) trabecular rods, extend forward in the usual positions of the dorsal and ventral margins of the trabecula. The third, and relatively much shorter process is attached posteriorly to the otic capsule just below the end of the dorsal trabecular rod. Curving downward and forward it fuses with the ventral trabecular rod. In the posterior end of the ventral trabecular rod there is a small

foramen traversed by a nerve (apparently the palatine). This foramen does not appear in the later stages modelled but I am unable to give the details of the disappearance.

After passing forward separately to the orbital region, the dorsal and ventral trabecular rods of each side are connected by two narrow bands of cartilage, a post-orbital (*pob*) and a pre-orbital (*prb*) between which the elongated optic foramen (*of*) is enclosed. Beginning in the region of the post-orbital band the dorsal and ventral trabecular rods of each side, which have thus far been approximately parallel, diverge in a horizontal direction. The dorsal rod curves first outward and then inward, giving off ventrally a plate-like lamina cribrosa near its anterior end. The two ventral rods bend inward to the median line where they unite to form a small ethmoid plate. Just behind their point of fusion each ventral rod gives off a ventro-lateral process which underlies the posterior end of the olfactory vesicle. From the anterior margin of the pre-orbital band of cartilage an antorbital process (Fig. 23, *anp*) extends outward and forward towards the ventral portion of the lamina cribrosa.

The quadrate is composed of a body, and ascending and pterygoid processes. The body is small and stands out from the side of the ventral trabecular rod below the anterior end of the ear capsule, with which it is not directly connected. The ascending process passes upward and forward and unites with the dorsal trabecular rod a little in front of the ear capsule. The pterygoid process (*pt*) is composed of two parts, a short proximal portion which projects forward from the body, and an isolated portion which later becomes the distal end of the process. This method of development of the pterygoid is the same as that mentioned by Gaupp ('91) for Siredon. A short dis-

tance in front of the distal portion of the pterygoid is another isolated rod of cartilage which runs in a direction diagonal to that of the pterygoid process. This is the palatine cartilage (*pc*).

Meckel's cartilage articulates with the ventral surface of the body of the quadrate. Anteriorly the cartilages of the two sides are still separated. They project backward behind the point of articulation with the quadrate nearly as far as the posterior end of the stapes (*a*).

Second stage. — (Figs. 24–26).— The parachordals and occipital processes are in the same condition as before, there being no trace of the formation of a synotic tectum. The notochord has entirely disappeared from the head region. The median wall of the otic capsule is more complete than it was in the first stage (Fig. 25). What was then the large anterior foramen is now divided into a dorsal foramen for the endolymphatic duct (*ef*) and a large ventral foramen for the auditory and facial nerves. The floor of the capsule is now composed of a median and a more lateral rod between which a fontanelle is enclosed. The stapes and fenestra ovalis are in the same condition as in the preceding stage.

The rod described in the first stage as connecting the anterior end of the otic capsule with the ventral trabecular rod now has a nearly vertical direction, the ventral end being relatively more posterior in position than before. As far forward as the orbital region there are no other noteworthy changes. In the nasal region, however, important changes have occurred. Instead of the transversely expanded nasal region of the earlier stage, we now find the anterior ends of the dorsal trabecular rods folded inward toward the nasal septum and forming a roof over the sides of the olfactory organs. By this movement the

lamina cribrosa is brought into its usual position. Its distal end is fused with that of the antorbital process thus enclosing the orbito-nasal foramen (Figs. 24 and 26, *on*).

The ethmoid plate is larger in both directions than in the first stage, and in the median line upon its anterior half arises the nasal septum (*ns*). In front, upon the sides of the base of the septum, the ethmoid plate terminates in short free processes. The nasal septum is divided anteriorly into three parts, a short median process which projects freely forward, and two lateral bands which curve forward and outward. At its most anterior point each of these bands divides into a dorsal and a ventral process. These extend backward along the lateral surface of the olfactory organ and fuse with the outer end of the cartilage mentioned in the first stage as arising from near the anterior end of the ventral trabecular rod. Where these three processes meet a plate of cartilage is formed which lies below the lamina cribrosa and is connected with it by a short narrow band. No tectal cartilage is formed in the chondrocranium of Ichthyophis.

As a result of ossification the ascending process of the quadrate has lost its cartilaginous connection with the dorsal trabecular rod (Fig. 24), and the parts of the pterygoid process are now united into one continuous rod. The body of the quadrate remains essentially unchanged, it having neither otic nor palato-basal process. The two cartilages of Meckel are now confluent in front, and the palatine cartilage still remains isolated from the rest of the chondrocranium. It appears that the ancestors of the Batrachia had a palato-pterygo-quadrate cartilage similar to that found in sharks. Of these cartilages the Urodeles as a rule retain only the pterygoid and quadrate portions. The Cæcilians have these two parts and an isolated palatine portion, while in the Anura all three parts are united

in one rod which is joined in front to the antorbital process.

The Cæcilian Chondrocranium.

There are two views according to which the Cæcilians are related to Amphiuma. According to one — the theory of Cope ('89[a]) — the Cæcilians are the extreme of a line of degeneration from the typical Urodele stock and Amphiuma is one of the intermediates of the series nearest to the Gymnophiona. Indeed, Cope goes so far as to make the Cæcilians merely a family of the Urodeles. The other view is that of the cousins Sarasin who hold that Amphiuma is a neotenic Cæcilian, a larval Cæcilian become sexually mature while retaining their branchial respiration.

According to the first view Amphiuma, and to a less extent the rest of the Urodeles, must be closely similar in cranial as well as other structures to the young Cæcilian. Farther, if we find that Amphiuma and the Urodeles have lost certain features which belonged to the ancestral Craniota, the retention of these characters by the Cæcilians would be an argument against the line of descent advocated. The view of the Sarasins presents even more difficulties for we have both horns of the dilemma. If Amphiuma be merely a Cæcilian arrested in a larval condition, then we have to say either that Amphiuma is not related to the remaining Urodeles or that they have all sprung from a Cæcilian ancestry. The objections to the second view are so many and so weighty that we think no one would care to defend it. The limbs alone are enough to set it aside. As to the other horn, it would seem that all the evidence we have regarding adult structure and development as well goes to show that Amphiuma is far more closely allied to the other Urodeles than it is to the Cæcilians, while the same matter of limbs, weak though

they be in Amphiuma, throws the whole view out of court.

There remains then but the view of Cope, and this is to be tested by seeing if there be features in the Cæcilians which must have been inherited and which could not have been inherited from an Urodele ancestor.

The parachordals of Ichthyophis are smaller than those of any other form studied. The nearest approach to them is found in Desmognathus where there are bands, not present in Ichthyophis, connecting the anterior end of the notochord with the otic capsules. No synotic tectum is formed in Ichthyophis, though at one period in the development of the skull small crests on the dorso-median walls of the otic capsules represent the first steps in the formation of a tectum. This appearance, however, is slight and but transitory.

There is a difference between the manner of development of the trabeculæ of Ichthyophis and those of the other Batrachia described. Instead of being developed by the successive formations of a ventral rod, a trabecular crest and a connective rod uniting the crest to the otic capsule, we have the dorsal rod developing simultaneously with the ventral rod and equally well chondrified. The dorsal rod, separated as it is from the ventral rod and attached to the anterior point of the otic capsule, somewhat resembles the supraorbital band of fishes. But the fusion of the ascending process of the quadrate with the dorsal rod and the relations of the two trabecular rods anteriorly are clearly Urodelan characters. The quadrate is peculiar, however, in having no otic or palato-basal processes. Aside from the ascending process and stapes it is entirely separated from the rest of the skull. Its position is the same as that of the Urodeles. The stapes is perforated for the stapedial artery.

But more important than any of the features mentioned above is the existence of an isolated palatine cartilage. This is especially noteworthy since it seems to furnish strong evidence in opposition to the theory of the Urodelan ancestry of the Cæcilians. Ranodon is the only Urodele which possesses that portion of the palato-pterygoid arch which may be considered to correspond to the palatine cartilage of Ichthyophis, while in Amphiuma there is not the slightest trace of it. We may therefore conclude that the condition found in Ichthyophis was not derived from an Urodelan ancestor but from some more primitive form.

The articular process of Meckel's cartilage is unusually long in Ichthyophis. The nasal capsules, while differing from all the others described, have no features of sufficient importance to be of any especial classificatory value.

The evidence which I have found, chiefly from a study of the chondrocranium, appears to me to be against associating the Cæcilians with any of the Urodeles and in favor of keeping them in a distinct group coördinate with the Urodela and Anura.

Polypterus bichir (Fig. 27).

In 1892 the late H. B. Pollard kindly allowed Dr. Kingsley to trace the outlines of the cartilages in the sections of the head of his youngest Polypterus. From these drawings I have made the chondrocranium in wax. Since the skull of this same specimen has already been described and figured by Pollard ('91) I shall deal chiefly with points of value from a comparative standpoint. For further details in regard to the relations of the chondrocranium to the rest of the head, reference should be made to Pollard's paper which contains a

dorsal view of the skull and drawings of sections through various parts of the head.

No cartilaginous occipital arch is present, owing, apparently, to ossification. The otic capsule is large and selachian-like in form. In its postero-lateral wall there is a large aperture exposing portions of the posterior and horizontal canals. This also is probably due to ossification. A small remnant of the hyomandibular cartilage (*h*) lies in a groove in the dorso-lateral surface of the capsule. That it formerly reached down as far as the posterior end of the pterygo-quadrate cartilage is shown by the figures of Pollard and others.

A thick synotic tectum covers the brain cavity in the posterior two-thirds of the otic region. There are indications of a medial capsular wall separating the brain cavity from the cavity of the capsule at its posterior and anterior ends, but the greater part of the space is entirely open. The floors of the capsules are continuous with the basilar plate which slightly exceeds the synotic tectum in extent. A peculiar rod of cartilage (*bo*) projects a short distance backward from beneath the middle of the basilar plate. At the anterior end of the capsules there are upon each side two foramina and a deep groove which is now open in front and apparently represents another foramen the anterior wall of which is ossified. A short bar of cartilage passes across the external opening of the posterior of the two foramina, dividing it here into two. The unossified posterior end of the supraorbital band remains as a solid lateral projection upon the anterior end of the otic capsule.

There is a complete separation of the chondrocranial elements of the otic region from those of the orbital and nasal regions. The supraorbital band (*sb*) passes anteriorly into a broad tegmen cranii (*tc*) which covers over

the anterior end of the cranial cavity and continues forward into the roof of the nasal capsules. Ventrally a solid plate of cartilage (*t*), the trabecular plate, forms a continuous floor beneath the anterior end of the cranial cavity and the nasal capsules, and projects forwards as a short and rather blunt rostrum (*r*). A small isolated plate of cartilage (*tc*) occupies the middle of the supracranial fontanelle, a remnant, as Pollard suggests, of a primitively complete tegmen cranii.

The nasal capsule consists of a large cavity enclosed by simple, broad plates of cartilage. Its floor and roof are connected by a tall septum medially and two bands laterally. The posterior of these two bands marks the boundary between nasal capsule and cranial cavity. There are three large apertures in the capsule walls: behind, the olfactory foramen; in front, the foramen for the nasal duct (*nl*); and between them a third in the lateral wall. Besides these there are two small foramina in the border of the nasal roof, the 'canalis ethmoidalis' (*ec*) and the 'canalis preorbitalis' (*prc*). Dorsally these two are connected by a deep groove.

The anterior end of the palato-pterygo-quadrate cartilage (*ppt*) is applied to the ventro-lateral surface of the nasal capsule. From here it passes backward as a broadening band to a point beneath the outer wall of the otic capsule and the hyomandibular cartilage. In passing from in front backward it twists from an approximately horizontal to a nearly vertical plane.

THE TROUT (*Salmo fontinalis*), (Figs. 28–29).

For a representative of the Teleostean skull I have modelled the chondrocranium of a trout embryo twenty-two mm. in length. The occipital arch is fused with the

otic capsules leaving no suggestion of their former separation, except in the jugular foramina (Fig. 29 *j*). The notochord extends forward beyond the middle of the otic region. Its sides are embraced by the two halves of the basilar plate. At its apex it projects freely forward for a short distance. Except for a small fontanelle (*f*), the basilar plate is continuous with the walls of the otic capsules which are united above by a broad, arched synotic tectum. The positions of the semicircular canals are clearly indicated in the external surface of the otic capsules. No median wall separates the cavity of the ear from that of the brain. In front and a little below the jugular foramen there is another smaller foramen through which the ninth nerve (*ix*) passes out of the cranium. Farther forward there are three more apertures in the ventral wall of the capsule. The posterior of these is the fontanelle mentioned above. The middle one of the three is small and is traversed by the hyomandibular branch of the facial nerve (*hy*). The anterior foramen is for the exit of a branch of the jugular vein (*jv*).

The basilar plate is continued forward into a trabecula upon either side. These extend separately to a point in front of the hypophysis and then unite along the median line in a narrow trabecular band. This band has the shape of an inverted trough and reaches to the anterior end of the skull, expanding in the nasal region into the ethmoid plate which forms the floor of the nasal capsules. The palatine branch of the seventh nerve (Fig. 28, *pal*) passes downward through a foramen in the posterior end of the trabecula. Two slender supraorbital bands (*sb*) arise from the anterior ends of the otic capsules and curve forward and inward, until about half way from the otic to the nasal region, where they enter the margins of the arched tegmen cranii which covers the anterior end of the

cranial cavity. This cranial roof is fused anteriorly with the dorsal end of the nasal septum (Fig. 28, *ns*.) In its anterior end there are three apertures, a median fontanelle and two small lateral foramina, through each of which passes a branch of the ophthalmicus superficialis (*rs*). A band of cartilage connecting the tegmen cranii and the dorsal end of the septum with the lateral border of the ethmoid plate separates the nasal region from the cranial cavity. There is no cartilaginous roof or lateral wall to the nasal capsule. The septum is thick and slightly expanded dorsally and in front where it ends bluntly.

The anterior end of the pterygo-quadrate cartilage is applied to the ventro-lateral margin of the ethmoid plate. From here it extends backward as a slender rod to beneath the anterior end of the otic capsule where it broadens into an irregular plate with an articular process ventrally for the attachment of Meckel's cartilage. Its posterior end is connected with the otic capsule by means of the plate-like hyomandibular cartilage (*h*). The dorsal margin of this cartilage, the hyomandibular, lies closely pressed against the external surface of the otic capsule just beneath the horizontal canal. It is broad and thin above and narrower and thicker below. From its ventral end a long rod-like process runs forward beneath the posterior end of the pterygo-quadrate, reaching almost to the point of articulation with Meckel's cartilage. The hyomandibular branch of the seventh nerve passes through a foramen just above the middle of this cartilage (*hy*).

The Chondrocranium in the Fishes.

The chondrocrania of the two types of this group which have been described have many features in common, and it seems probable that a comparison of corres-

ponding stages in the development of the two forms would show a still more marked similarity. The otic capsules are connected dorsally by a solid synotic tectum and ventrally by an unbroken basilar plate formed by the fusion of the parachordals around the anterior end of the notochord. The median wall of the otic capsule is either absent or but slightly developed. Neither fenestra ovalis nor stapes occurs.

The trabeculæ unite ventrally into a median band in front of the hypophysis and continue forward to the end of the skull. At its anterior end the trabecular band broadens out into the ethmoid plate which forms the floor of the nasal capsules. Supraorbital bands extend forward from the anterior ends of the otic capsules to the lateral margins of the tegmen cranii which roofs over the anterior portion of the brain cavity.

The palato-pterygo-quadrate cartilage extends from the lateral margin of the ethmoid plate backward to beneath the anterior end of the otic capsule. Its posterior end is supported to a greater or less degree by the ventral end of the hyomandibular cartilage which has its dorsal end closely applied against the outer wall of the otic capsule. Meckel's cartilage articulates with the ventral surface of the quadrate portion of the palato-pterygo-quadrate cartilage.

In discussing the relations of Polypterus to the Batrachia, Pollard said, "On comparing the primordial cranium of a young Polypterus with that of Urodeles, the general resemblance is seen to be so great that an anatomist seeing it alone for the first time would certainly place it among the latter." Considering the features which distinguish the chondrocranium of Polypterus in common with the rest of the Fishes from that of the Batrachia, as outlined in the preceding pages, so great a similarity can

hardly be admitted to exist. The great similarity pointed out above between the skulls of Polypterus and the trout and the many points in which they differ from the typical skull of the Batrachia cause me to feel considerable hesitancy about accepting the theory of the Crossopterygian ancestry of the Batrachia. But, while the presence in Polypterus of a large hyomandibular cartilage, a quadrate well removed from the otic capsule and a strong supraorbital band, as well as the absence of any fenestra ovalis or stapes, will remain important obstacles to this view until transitional stages are found, perhaps these difficulties are less than those attending the Dipnoan theory. Attention may also be called to the fact that in Polypterus there is a limited median capsular wall, which is not found in either the trout or Protopterus but which regularly occurs in the Batrachia.

Protopterus annectens (Figs. 30–32).

A model of the chondrocranium of Protopterus gives us a basis from which to compare the Dipnoi on the one hand with the Batrachia, to which they have been considered to be closely related, and on the other to the Teleosts and Ganoids.

Viewed as a whole the massive character of many of the cartilages of this skull is a most striking feature. Ossification in the occipital region somewhat obscures the relations between the skull and the first vertebra. The occipital processes are fused with the otic capsules leaving large jugular foramina in the usual position. The remnant of the notochord is imbedded in a solid parachordal plate extending from the posterior end of the skull forward to the middle of the otic region. On each side of the median line at the anterior end of the parachordal plate is an

elongate fontanelle (Fig. 32, *f*). The walls of the otic capsules are continuous ventrally with the parachordal plate and dorsally with a strong synotic tectum. From the external margin of the otic capsule a broad ledge of cartilage projects horizontally outward, widening as it passes from behind forward where it terminates abruptly. There is no median capsular wall.

Band-like trabeculæ extend forward along the sides of the brain from the dorsal anterior end of the otic capsules to the optic region where they bend around ventrally to form a large ethmoid plate. From the dorsal margin of the anterior end of each trabecula a peculiarly bent antorbital process (*anp*) arises. It projects forward and outward, coming into close proximity to, but not fusing with the posterior end of the nasal capsule, and then it bends backward, running along the margin of the upper lip. The ethmoid plate narrows down in passing from behind forward, and terminates in two processes which bend sharply upward and fuse with the posterior end of the nasal septum. Between these two terminal processes there is an oval fontanelle.

The nasal capsule is a very peculiar one. The septum is a thin dorsal plate behind, but in front it becomes a solid cylindrical mass of cartilage projecting ventrally between the olfactory organs. The transition from one condition to the other is very abrupt. In front the septum ends in two short laterally directed processes. Six bands of cartilage extend outward and downward from the median septum to a curved marginal band (*mr*). Between these bands five apertures of various shapes and sizes are enclosed. The anterior of the six transverse bands projects somewhat beyond its point of fusion with the marginal band. As is seen in the ventral view (Fig. 32) a curved process extends inward and upward from the inner

border of the marginal band. Its dorsal end is free. Just in front of the bend of the antorbital process is an isolated strip of cartilage occupying a diagonal position, one end being dorso-medial and the other ventro-lateral. A small cylindrical rod (*tc*) extends backward in the median line from the posterior end of the nasal septum and ends freely above the brain, a remnant of the ancestrally complete tegmen cranii.

The quadrate has its base firmly fused with the otic capsule and trabecula. It is a solid mass projecting downward and forward, and presents upon its anterior end a large articular surface for the enormous posterior end of Meckel's cartilage (Fig. 30). Except for a short distance in front of its point of articulation, Meckel's cartilage is of only ordinary size. There are upon each side of the lower jaw three labial cartilages (*lc*). As shown in the figure the posterior of these is separated from the jaw and divided into two parts, but this occurred upon the right side only. By mistake the anterior end of the lower jaw was drawn nearly straight instead of curved sharply upward as it should have been.

The ninth nerve (*ix*) passes out through a small foramen a short distance in front of the jugular foramen. Five foramina grouped about the anterior end of the otic capsule open upon the dorso-lateral surface of the skull. I have designated the nerves passing through these foramina in accordance with the work of Pinkus ('94). The third nerve passes through a small foramen (Fig. 30, *oc*) near the dorsal margin of the trabecula. Just below the foramen for the third is a larger one for the ramus ophthalmicus profundus of the fifth (*rp*), and still lower is another for the ramus maxillaris of the fifth (*rm*). A short distance behind this foramen are the openings of the other two lying close together, one above the other. The

more dorsal of the two is traversed by two nerves, the ramus lateralis facialis of the seventh (*rl*) and the ramus ophthalmicus superficialis of the fifth (*rs*). The more ventral foramen is for a blood vessel (*b*).

Three foramina open upon the ventral surface of the skull in this same region (Fig. 32). Of these the anterior and smallest is for the ramus palatinus superior (*rps*). The other two openings are close together. The more median is for the main trunk of the seventh (*vii*) and the ramus palatinus inferior (*rpi*). The more lateral opening is the ventral end of the foramen for the blood vessel mentioned above.

The Chondrocranium in the Dipnoi.

A comparison of the chondrocranium of Protopterus with those of the Batrachia and Fishes at once reveals its unique character. While resembling the typical chondrocranium of each of these groups in some respects, taken as a whole it is very different from either. The large otic capsule, with thick walls and separate foramen for the ninth nerve, and without a median wall or fenestra ovalis, greatly resembles the capsule of Fishes. But the suspensorial apparatus is entirely different from that of most Fishes and very similar to that of the Batrachia, that is to say, it is autostylic. According to Huxley ('76) this condition is also found in the Chimæroids and Marsipobranchii, but in none of the other Fishes. This is undoubtedly the strongest point of resemblance between the chondrocrania of the Dipnoi and Batrachia. And here the theory of the Dipnoan ancestry of the Batrachia is decidedly at an advantage over the Crossopterygian theory. But this similarity of the otic relations of the quadrate in these two forms is counterbalanced by differ-

ences in other respects. The absence of a palato-pterygoid cartilage is an especially noteworthy feature in this connection which indicates the highly specialized nature of this skull and renders it impossible to consider it a very near approach to the ancestral Batrachian skull.

The trabeculæ are unlike both those of the Fishes and those of the Batrachia. When their posterior ends are compared with the chondrocranium of the former group they seem rather to represent the supraorbital bands, arising as they do from the antero-dorsal surface of the otic capsules. But in passing forward, instead of curving up over the eye as supraorbital bands should do, they curve downward and fuse at their anterior ends into an ethmoid plate very much as occurs in the Batrachia. The antorbital process arises from the dorsal margin of the trabecula, a condition found in none of the other forms studied; and the ethmoid plate, instead of continuing forward to form a floor beneath the nasal capsules, as is the general method in both Fishes and Batrachia, curves sharply upward at its anterior end and fuses with the dorsally situated posterior end of the nasal septum. The possession of a remnant of the tegmen cranii is another fish-like character.

As was mentioned in the discussion of the chondrocranium of Necturus, there is some resemblance between the nasal capsules of that form and those of Protopterus. But, in view of the differences between the nasal capsules of the various forms of Urodeles themselves and considering the many important points of difference in other parts of the skull, it seems to me an entirely unwarrantable conclusion to assume any phyletic relationship between these two forms upon this account.

Günther has described the skull of Ceratodus as consisting "of a completely closed inner cartilaginous

capsule and an outer incomplete osseous case, to which, again, some other cartilaginous elements are appended." From this description and from the fact that a cartilage considered to be a remnant of the hyomandibular has been found in Ceratodus it seems probable that the chondrocranium of this form resembles that of the Fishes more than does that of Protopterus. But the evidence from the chondrocranium of Protopterus, in so far as it may be considered to have value in determining the position of the Dipnoi as a whole, appears to me to be entirely in agreement with the conclusion of W. N. Parker that, "it is certainly inadvisable to retain the Dipnoi among the Fishes, as is still done by some zoologists, and it would be still more undesirable to place them with the Amphibia." It is to be remembered, however, that Protopterus is one of the more specialized forms of the group.

Postscript.

Since the foregoing article passed into the hands of the printer a paper by Miss Platt[1] has appeared which deals with the development of the cartilaginous skull of Necturus, giving special attention to the origin of the procartilage cells. In the main our results in regard to the fully chondrified parts entirely agree. Miss Platt finds, however, that in Necturus the number of cartilages arising independently is considerably larger than that described above for Amblystoma. Of these the synotic tectum ('tectum interoccipitale'), the trabecular crest, and the ethmoid ('internasal') plate are of particular interest

[1] Platt, J. B. The development of the cartilaginous skull and of the branchial and hypoglossal musculature in Necturus. Morph. Jahrbuch. XXV, p. 377. 1897.

from the fact that I have not found them to appear as independent cartilages in any of the forms studied. This may, in some cases, be due to the fact that the independent condition is limited to the pro-cartilage stages or to the incompleteness of my series of embryos. But I feel confident that the parts mentioned do not appear as independent cartilages in Amblystoma. The existence of such a condition as that shown in Fig. 18, where there is no sign of cartilage near the median line, and the appearance of a complete tectum in an embryo but little older form the basis of my conclusions in regard to the synotic tectum. My evidence as to the formation of the trabecular crests and the ethmoid plate is of the same nature and shows them to be outgrowths from the primitive trabeculæ.

BIBLIOGRAPHY.

'40 Bischoff, Th. Lepidosiren paradoxa. Ann. Sci. Nat. 1840.

'86 Cope, E. D. On the structure and affinities of the Amphiumidæ. Proc. Am. Phil. Soc. XXIII. 1886.

'89 Cope, E. D. On the relations of the hyoid and otic elements of the skeleton in the Batrachia. Jour. Morphol. II. 1889.

'89*a* Cope, E. D. The Batrachia of North America. Bull. of U. Natl. Museum. No. 34. 1889.

'95 Dollo, Louis. Sur la Phylogénie des Dipneustes. Bull. Soc. belg. Géol., Paleont. et Hydr. IX. 1895.

'35 Dugès, A. Recherches sur l'ostéologie et la myologie des Batrachiens. Mémoires present. à l'Acad. roy. d. Sci. VI. Paris 1835.

'89 Ecker, A. und Wiedersheim, R. Anatomie des Frosches. Braunschweig 1864–1882. Trans. by Geo. Haslam, M.D. 1889.

*'49 Friedreich, N., und Gegenbaur, C. Der Schädel des Axolotl. Berichte v. d. kgl. zootom. Anstalt zu Würzburg. Zweiter Bericht f. d. Schuljahr 1847–48. Leipzig 1849.

'91 Gaupp, E. Zur Kentniss des Primordial-Craniums der Amphibien und Reptilien. Verhandl. d. anat. Gesell. auf der V. Vers. in München. 1891.

'93 Gaupp, E. Beitrag zur Morphologie des Schädels. I. Primordial-Craniums und Kieferbogen von Rana fusca. Morphol. Arbeiten herausgeg. v. G. Schwalbe. II. 1893.

'94 Gaupp, E. Beiträge zur Morphologie des Schädels. III. Zur vergleichenden Anatomie der Schläfengegend am knöchernen Wirbelthier Schädel. Morph. Arbeit. v. Schwalbe. IV. 1894.

'72 Gegenbaur, C. Untersuchungen zur vergleichenden Anatomie der Wirbelthiere. III. Das Kopfskelet der Selachier. Leipzig 1872.

'75 Goette, A. Entwicklungsgeschichte der Unke. Leipzig 1875.

'92 Goronowitsch, N. Die axiale und die laterale Kopfmetamerie der Vogelembryonen. Anat. Anz. VII. 1892.

'93 Goronowitsch, N. Untersuchungen über die Entwicklung der sogenannten "Ganglienleisten" im Kopfe der Vogel. embryonen. Morph. Jahrb. XX. 1893.

'93[a] Goronowitsch, N. Weiteres über die ektodermal Entstehung von Skeletanlagen im Kopf der Wirbelthiere. Morph. Jahrb. XX. 1893.

'71 Günther, A. Description of Ceratodus. Phil. Trans. clxi. 1871.

'80 Günther, A. An introduction to the study of fishes. Edinburgh 1880.

'73 Hasse, C. Ueber den Bau des Gehörorganes von Siredon pisciformis und über die vergleichende Anatomie des Kiefersuspensorium. Anat. Studien. I. Leipzig 1873.

'90 Hay, O. P. The skeletal anatomy of Amphiuma during its earlier stages. Jour. Morphol. IV. 1890.

'73–'78 Hoffmann, C. K. "Amphibien" in Bronn's "Klassen und Ordnungen des Thierreiches."

'71 Huxley, T. H. A manual of the anatomy of vertebrated Animals. London 1871.

'74 Huxley, T. H. On the structure of the skull and of the heart of Menobranchus lateralis. Proc. Zool. Soc. Lond. 1874.

'75 Huxley, T. H. Amphibia. Encyc. Britan. Ninth Ed.

'76 Huxley, T. H. Ceratodus fosteri. Proc. Zool. Soc. Lond. 1876.

'76[a] Huxley, T. H. The nature of the cranio-facial apparatus of Petromyzon. Jour. Anat. and Phys. X. 1876.

'45 Hyrtl, J. Lepidosiren paradoxa. Abhandl. d. böhm. Gesell. Prag 1845.

'88 Kastschenko, N. Zur Entwicklung des Selachierembryos. Anat. Anz. III. 1888.

'92 Kingsley, J. S. The head of an embryo Amphiuma. Am. Nat. 1892.

'94 Klaatsch, H. Ueber Herkunft der Skleroblasten. Morph. Jahrb. XXI. 1894.

'95 Klaatsch, H. Ueber die Bedingung der Hautsinnesorgane für die Ausschaltung der Skleroblastem aus dem Ektoderm. Verhandl. Anat. Gesell. 9 Vers. Basel 1895.

*'49 Kölliker, A. Allgemeine Betrachtungen über die Entstehung des knöchernen Schädels der Wirbelthiere. Berichte v. d. kgl. Zootom. Anstalt zu Würzburg. Leipzig 1849.

'95 Von Kupffer, C. Ueber die Entwicklung des Kiemenskelets von Ammocoetes und die organogene Bestimmung des Exoderms. Verhandl. Anat. Gesell. a. d. 9 Vers. in Basel. 1895.

'92 Minot, C. S. Human Embryology. New York 1892.

'70 Parker, W. K. On the structure and development of the skull of the common frog. Phil. Trans. Roy. Soc. Lond. Vol. 161. 1870.

'74 Parker, W. K. On the structure and development of the skull in the salmon. Phil. Trans. Vol. 173. 1874.

'76 Parker, W. K. On the structure and development of the skull in the Batrachia. Pt. II. Phil. Trans. Vol. 166, f. 1876.

'81 Parker, W. K. On the structure and development of the skull in the Batrachia. Pt. III. Phil. Trans. Vol. 172 f. 1881. London 1882.

'82 Parker, W. K. On the structure and development of the skull in sturgeons. Phil. Trans. 173. 1882.

'82[a] Parker, W. K. On the development of the skull in Lepidosteus osseus. Phil. Trans. Vol. 173. 1882.

'78 Parker, W. K. On the structure and development of the skull in sharks and skates. Trans. Zool. Soc. X. 1878.

'77 Parker, W. K. and Bettany, G. T. The morphology of the skull. London 1877.

'92 Parker, W. N. On the anatomy and physiology of Protopterus annectens. Trans. Roy. Irish Acad. XXX. 1892.

'94 Pinkus, F. Die Hirnnerven des Protopterus annectens. Morphol. Arbeiten v. G. Schwalbe. IV. 1894.

'93 Platt, J. B. Ectodermic origin of the cartilages of the head. Anat. Anz. VIII. 1893. Also in Tufts College Studies No. I. 1893.

'94 Platt, J. B. Ontogenetische Differenzirung des Ektoderms in Necturus. Arch. f. mikr. Anat. XLIII. 1894.

'91 Pollard, H. B. On the anatomy and phylogenetic position of Polypterus. Zool. Jahrb. V. 1891.

'94 Pollard, H. B. The suspension of the jaws in fish. Anat. Anz. X. 1894.

'95 Pollard, H. B. Ueber Labialknorpel. Verhandl. Anat. Gesell. 9 Vers. in Basel. 1895.

'39 Rathke, H. Bemerkungen über die Entwicklung des Schädels der Wirbelthiere. Vierter Bericht über das naturwissenschaftliche Seminar zu Königsberg. Kgsbg. 1839.

'38 Reichert, C. B. Vergleichende Entwicklungsgeschichte des Kopfes der nackten Amphibien. Königsberg 1838.

'92 Röse, C. Ueber Zahnbau und Zahnwechsel der Dipnoi. Anat. Anz. VII. 1892.

'84 Sagemehl, M. Beiträge zur vergleichenden Anatomie der Fische. I. Das Cranium von Amia calva. Morphol. Jahrb. IX. 1884.

'85 Sagemehl M. Beiträge zur vergleichenden Anatomie der Fische. III. Das Cranium der Chariciniden. Morphol. Jahrb. X. 1885.

'91 Sagemehl, M. Beiträge zur vergleichenden Anatomie der Fische. IV. Das Cranium der Cyprinoiden. Morphol. Jahrb. XVII. 1891.

'90 Sarasin, P. und F. Ergebnisse naturwissenschaftlicher Forschungen auf Ceylon in den Jahren 1884–86. II. Zur Entwicklungsgeschichte und Anatomie der ceylonesischen Blindwühle, Ichthyophis glutinosus. Wiesbaden 1890.

'96 Schaffer, J. Ueber das knorpelige Skelet von Ammocoetes branchialis nebst Bemerkungen über das Knorpelgewebe im Allgemeinen. Zeit. wiss. Zool. LXI. 1896.

'91 Sewertzoff. A. N. Ueber einige Eigenthümlichkeiten in der Entwicklung des Schädels von Pelobates fuscus. Bull. Soc. Imp. Nat. Moscou. 1891.

'97 Sewertzoff, A. N. Beitrag zur Entwicklungsgeschichte des Wirbeltierschädels. Anat. Anz. XIII. 1897.

'79 Stöhr, Ph. Zur Entwicklungsgeschichte des Urodelenschädels. Zeits. wiss. Zool. XXXIII. 1879.

'81 Stöhr. Ph. Zur Entwicklungsgeschichte des Anurenschädels. Zeits. wiss. Zool. XXXVI. 1881.

*'82 Stöhr, Ph. Zur Entwicklungsgeschichte des Teleostier-Schädels. Festschrift zur Feier des 300 jährigen Bestehens der Universität Würzburg. Leipzig 1882.

'71 Traquair. On the cranial osteology of Polypterus. Jour. Anat. and Phys. V. 1871.

'90 Villy, F. The development of the ear and accessory organs in the common frog. Quar. Jour. Mic. Sci. XXX. 1890.

*'73 Vrolik, J. A. Studien uber die Verknöcherung und die Knochen des Schädels der Teleostier. Niederl. Archiv f. Zool. I. 1873.

'77 Wiedersheim, R. Das Kopfskelet der Urodelen. Morph. Jahrb. III. 1877.

'79 Wiedersheim, R. Die Anatomie der Gymnophionen. Jena 1879.

'80 Wiedersheim, R. Das Skelet von Pleurodeles watlii. Jenaische Zeits. XIV. 1880.

'80 Wiedersheim, R. Das Skelet und Nervensystem von Lepidosiren annectens. Jena. Zeits. XIV. 1880.

'93 Wiedersheim, R. Lehrbuch der vergleichenden Anatomie. 3 Aufl. Jena 1893.

'92 Wilder, H. H. Die Nasengegend von Menopoma alleghaniense und Amphiuma tridactylum. Zool. Jahrb. V. 1892.

'91 Wilder, H. H. A contribution to the anatomy of Siren lacertina. Zool. Jahrb. IV. 1891.

'93 White, P. J. The skull and visceral skeleton of the Greenland shark, Laemargus microcephalus. Trans. Roy. Soc. Edinburg. XXXVII. 1893.

EXPLANATION OF THE FIGURES.

REFERENCE LETTERS.

a. Angular process.
a n p. Antorbital process.
a p. Ascending process.
a s. Arteria perforans stapedia.

b Foramen for blood vessel.
b o. Basi-occipital cartilage.
b q. Body of quadrate.

c. Cornu trabeculæ.

d. Dorsal nasal process.
d p. Descending process of quadrate.
d r. Dorsal trabecular rod.

* Not seen.

e.	Ethmoid plate.
e c.	Ethmoid canal.
e f.	Endolymphatic foramen.
f.	Fontanelle.
f o.	Fenestra ovalis.
h.	Hyomandibular cartilage.
h y.	Foramen for hyomandibular branch of seventh nerve.
i x.	Foramen for ninth nerve.
j.	Jugular foramen.
j v.	Foramen for branch of jugular vein.
l.	Lamina cribrosa.
l c.	Labial cartilage.
l o c.	Lateral occipital crest.
m.	Meckel's cartilage.
m r.	Marginal rod.
n.	Notochord.
n c.	Nasal capsule.
n i.	Foramen for branch of nasalis internus.
n l.	Nostril.
n s.	Nasal septum.
o.	Otic capsule.
o c.	Oculomotor foramen.
o c p.	Occipital process.
o f.	Optic foramen.
o l.	Olfactory foramen.
o n.	Orbito-nasal foramen.
o p.	Otic process.
p.	Parachordal.
p a l.	Palatine foramen.
p b.	Palato-basal process.
p c.	Palatine cartilage.
p f.	Perilymphatic foramen.
p o b	Postorbital band.
p p t.	Palato-pterygo-quadrate cartilage.
p r b.	Preorbital band.
p r c.	Preorbital canal.
p t.	Pterygoid process.
q.	Quadrate.

r.	Rostrum.
r l.	Foramen for ramus lateralis facialis of the seventh nerve.
r m.	Foramen for ramus maxillaris of fifth nerve.
r n.	Foramen for ramus mandibularis of fifth nerve.
r p.	Foramen for ramus ophthalmicus profundus of fifth nerve.
r p i.	Foramen for ramus palatinus inferior.
r p s.	Foramen for ramus palatinus superior.
r s.	Foramen for ramus ophthalmicus superficialis of fifth.
s.	Stapes.
s b.	Supraorbital band.
s p.	Stapedial process.
s t.	Synotic tectum.
s u.	Support of balancer.
t.	Trabecula.
t a.	Tympanic annulus.
t c.	Tegmen cranii.
t e.	Tectal cartilage.
t m.	Taenia tecti medialis.
tr c.	Trabecular crest.
v.	Foramen for branch of fifth nerve.
vii.	Foramen for branch of seventh nerve.
viii.	Foramen for branch of eighth nerve.
v p.	Ventral nasal process.
v r.	Ventral trabecular rod.

EXPLANATION OF PLATE.

Fig. 1. Side view of model from *Amblystoma punctata*, ten mm. long.

Fig. 2. Dorsal view of same.

Fig. 3. Dorsal view of model from *Amblystoma punctata*, eleven mm. long.

Fig. 4. Side view of model from *Amblystoma punctata*, twelve mm. long.

Fig. 5. Dorsal view of same.

Fig. 6. Ventral view of same.

Fig. 7. Dorso-median view of otic capsule of same.

Fig. 8. Side view of model from *Amblystoma jeffersoniana*, thirty-nine mm. long.

Fig. 9. Dorsal view of same.

[illegible]

r.	Rostrum.
r l.	Foramen for ramus lateralis facialis of the seventh nerve.
r m.	Foramen for ramus maxillaris of fifth nerve.
r n.	Foramen for ramus mandibularis of fifth nerve.
r p.	Foramen for ramus ophthalmicus profundus of fifth nerve.
r p i.	Foramen for ramus palatinus inferior.
r p s.	Foramen for ramus palatinus superior.
r s.	Foramen for ramus ophthalmicus superficialis of fifth.
s.	Stapes.
s b.	Supraorbital band.
s p.	Stapedial process.
s t.	Synotic tectum.
s u.	Support of balancer.
t.	Trabecula.
t a.	Tympanic annulus.
t c.	Tegmen cranii.
t e.	Tectal cartilage.
t m.	Taenia tecti medialis.
tr c.	Trabecular crest.
v.	Foramen for branch of fifth nerve.
vii.	Foramen for branch of seventh nerve.
viii.	Foramen for branch of eighth nerve.
v p.	Ventral nasal process.
v r.	Ventral trabecular rod.

EXPLANATION OF PLATE.

Fig. 1. Side view of model from *Amblystoma punctata*, ten mm. long.
Fig. 2. Dorsal view of same.
Fig. 3. Dorsal view of model from *Amblystoma punctata*, eleven mm. long.
Fig. 4. Side view of model from *Amblystoma punctata*, twelve mm. long.
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Fig. 6. Ventral view of same.
Fig. 7. Dorso-median view of otic capsule of same.
Fig. 8. Side view of model from *Amblystoma jeffersoniana*, thirty-nine mm. long.
Fig. 9. Dorsal view of same.

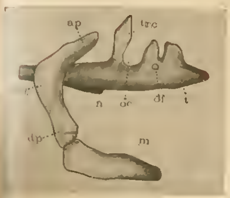

FIG. 1

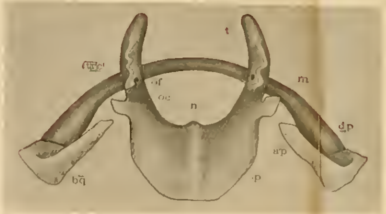

FIG. 2

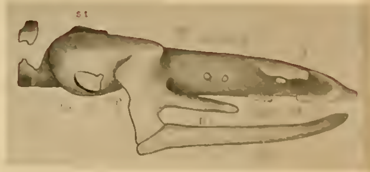

FIG 8

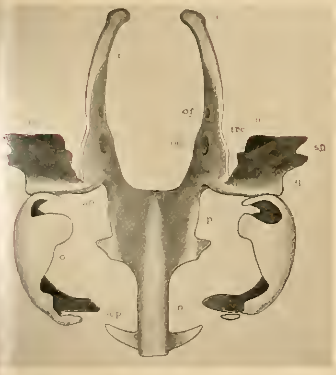

FIG. 3

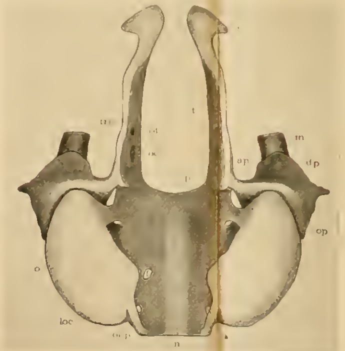

FIG. 5

FIG. 4

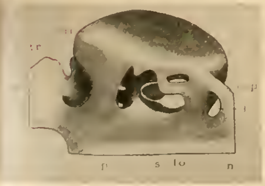

FIG. 7

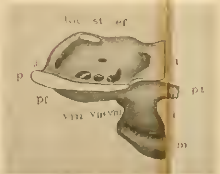

FIG. 11

FIG. 6

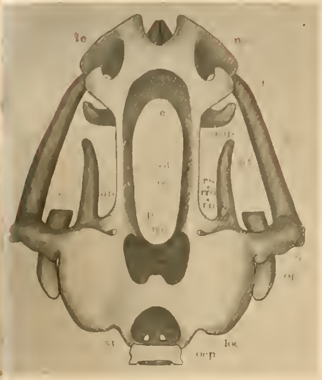

FIG 9

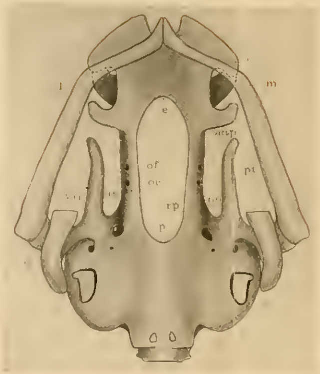

FIG. 10

FIG. 12

FIG. 13

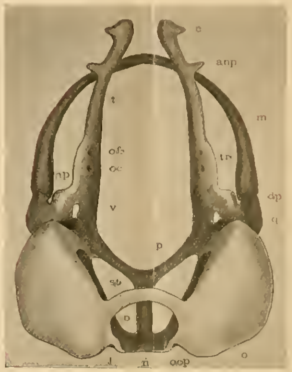

FIG. 14

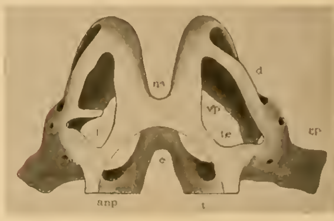

FIG. 15

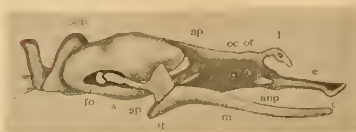

FIG. 17

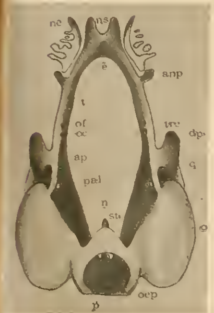

FIG. 16

FIG. 18

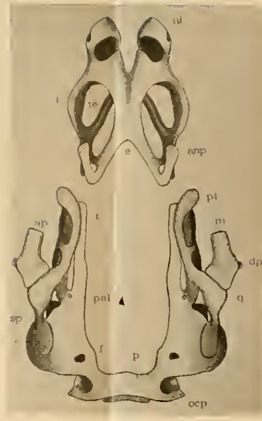

FIG. 19

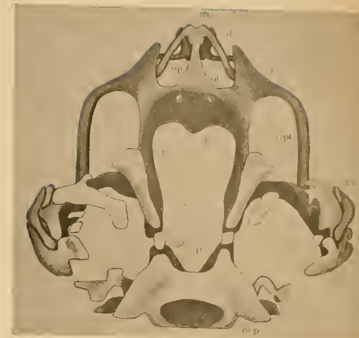

FIG 20

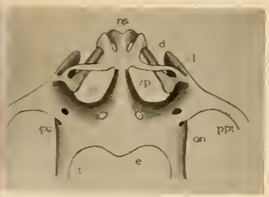

FIG. 21

FIG. 24

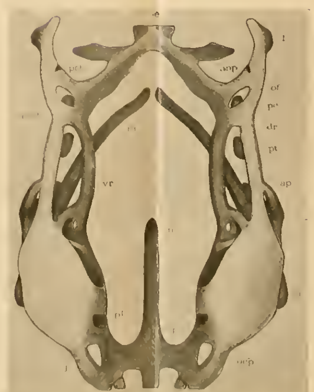

FIG. 22

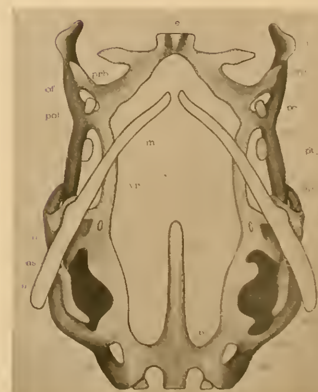

FIG. 23

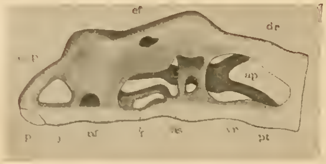

FIG. 25

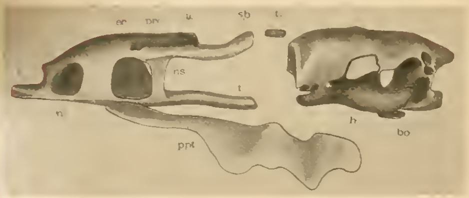

FIG 27

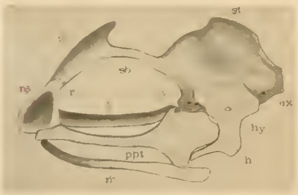

FIG 28

FIG 30

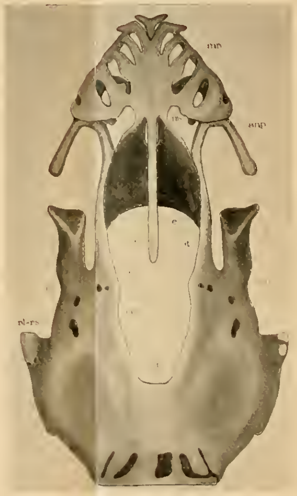

FIG. 31

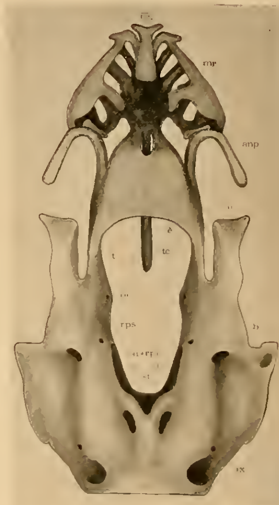

FIG. 32

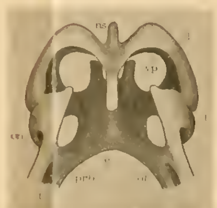

FIG 26

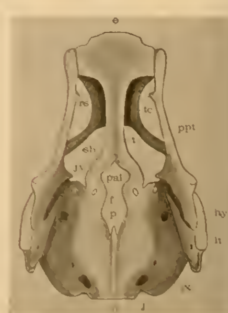

FIG. 29

Fig. 10. Ventral view of same.
Fig. 11. Median view of otic capsule of same.
Fig. 12. Dorsal view of model from *Amblystoma punctata*, sixty-nine mm. long.
Fig. 13. Ventral view of same.
Fig. 14. Dorsal view of model from *Desmognathus fusca*, twenty mm. long.
Fig. 15. Dorsal view of model of nasal capsules from *Plethodon glutinosum*, twenty mm. long.
Fig. 16. Dorsal view of model from *Necturus maculatus*, forty-five mm. long.
Fig. 17. Side view of model from young *Amphiuma means*.
Fig. 18. Dorsal view of same.
Fig. 19. Ventral view of model from older *Amphiuma*.
Fig. 20. Dorsal view of model from *Pipa americana*.
Fig. 21. Ventral view of nasal region of same.
Fig. 22. Dorsal view of model from young *Ichthyophis glutinosus*.
Fig. 23. Ventral view of same.
Fig. 24. Side view of model from older *Ichthyophis glutinosus*.
Fig. 25. Median view of otic region of same.
Fig. 26. Dorsal view of nasal capsules of same.
Fig. 27. Side view of model from young *Polypterus bichir*.
Fig. 28. Side view of model from trout twenty-two mm. long.
Fig. 29. Ventral view of same.
Fig. 30. Side view of model from young *Protopterus annecteus*. (See text, p. 130, for error in shape of Meckel's cartilage.)
Fig. 31. Dorsal view of same.
Fig. 32. Ventral view of same.